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The U.S. Coast Guard's Deepwater Force Modernization Plan

Can It Be Accelerated? Will It Meet Changing Security Needs?

John Birkler, Brien Alkire, Robert Button, Gordon Lee, Raj Raman, John Schank, Carl Stephens

Prepared for the United States Coast Guard

RAND NATIONAL SECURITY RESEARCH DIVISION

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Preface

In November 2002, the United States Coast Guard (USCG) commissioned the RAND Corporation to assess its Deepwater program, an effort the USCG is undertaking to slowly, but steadily, replace or modernize nearly 100 aging cutters and more than 200 aircraft over the next 20 years. Known more formally as the Integrated Deepwater System program, this endeavor aims to equip the USCG with state-of-the-art cutters, aircraft, helicopters, and unmanned air vehicles. All of its activities will be orchestrated through an integrated Command, Control, Communications, Computing, Intelligence, Surveillance, and Reconnaissance (C4ISR) system and an Integrated Logistics System (ILS). The program, the largest and most complex acquisition effort in USCG history, was originally designed to maintain the status quo at the USCG as it pursues its traditional missions as part of its roles of maritime security, maritime safety, protection of natural resources, maritime mobility, and national defense.[1]

RAND's research is intended to help USCG decisionmakers evaluate whether the Deepwater program—which was conceived and put in motion before the September 11, 2001, terrorist attacks and before the USCG's subsequent transfer into the newly created Department of Homeland Security—remains valid for the new and

[1] As defined in *U.S. Coast Guard: America's Maritime Guardian* (U.S. Coast Guard [USCG], 2002c, pp. 62–63), *roles* are "the enduring purposes for which the Coast Guard is established and organized." *Missions* are "the mandated services the Coast Guard performs in pursuit of its fundamental roles" and "tasks or operations assigned to an individual or unit." Note that the five USCG roles are also the USCG's five strategic performance goals (see Appendix A).

evolving responsibilities and missions that the USCG has been asked to shoulder. The events of September 11 gave new urgency to accelerating asset acquisition (Biesecker, 2004). RAND was asked to evaluate whether the current Deepwater acquisition plan will provide the USCG with an adequate number and array of cutters, aircraft, and other assets to meet changing operational demands.[2]

RAND's assessment involved two parallel evaluations:

- *An exploration of issues connected with speeding up, compressing, or otherwise accelerating the pace at which the USCG can acquire surface and air assets that it will operate in the* deepwater environment, *defined as territory 50 or more nautical miles from shore.* As part of this examination, RAND was asked to look at the implications for force structure, cost, performance, and industrial base of commissioning all replacement assets, decommissioning all outmoded or old-technology (so-called legacy) assets, and completing all modernization tasks earlier than the year 2022.
- *A determination of whether the original Deepwater plan would provide the USCG with a force structure to meet mission demands.* RAND was asked to evaluate the force structure that the original Deepwater acquisition plan would provide and define the boundaries of a force structure that would fulfill the USCG's demands of traditional missions and emerging responsibilities.

This report should be of special interest both to the USCG and to uniformed and civilian decisionmakers involved in homeland security and homeland defense. It was prepared for the Program Executive Officer, Integrated Deepwater System, USCG. This research was conducted within the Acquisition and Technology Policy Center of the RAND National Security Research Division (NSRD), a division of the RAND Corporation. NSRD conducts research and analysis for the Office of the Secretary of Defense, the Joint Staff, the Unified

[2] Our analysis addresses only those assets needed to operate in the deepwater environment; it does not address assets needed to satisfy demands outside the deepwater environment.

Commands, the defense agencies, the Department of the Navy, the U.S. intelligence community, allied foreign governments, and foundations. For more information on RAND's Acquisition and Technology Policy Center, contact the Director, Gene Gritton. He can be reached by e-mail at *gene_gritton@rand.org*; by phone at 310-393-0411, extension 6933; or by mail at RAND Corporation, 1700 Main Street, Santa Monica, California 90407-2138. More information about RAND Corporation is available at *www.rand.org*.

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RAND routinely reviews and refines its quality assurance process and also conducts periodic external and internal reviews of the quality of its body of work. For additional details regarding the RAND quality assurance process, visit *http://www.rand.org/standards/*.

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Summary

The United States Coast Guard's (USCG's) slow, but steady effort to replace and modernize many of its cutters, patrol boats, and air vehicles—conceived and put in motion before the September 11, 2001, terrorist attacks and officially known as the Integrated Deepwater System program[1]—will not provide the USCG with adequate assets and capabilities to fulfill demands[2] for traditional missions and emerging responsibilities.[3] To satisfy these demands, the USCG will need the capabilities of twice the number of cutters and 50 percent more air vehicles than it has been planning to acquire over the next two decades. It cannot gain these capabilities merely by buying the assets in the current program over 10 or 15 years instead of over 20 years. Rather, it can gain these capabilities only by acquiring significantly more cutters, unmanned air vehicles (UAVs), and helicopters than are in the current acquisition program, or by mixing into the

[1] Throughout this document, we refer to the Integrated Deepwater System program as Deepwater or the Deepwater program.

[2] One RAND objective in conducting the analyses was to avoid overstating asset demand. Because much of the evaluation of performance is subjective and, hence, hard to quantify, we used *asset presence* as a proxy for *performance*—crediting assets with 100-percent effectiveness. Assets are clearly not 100-percent effective, which indeed systematically constrained us from overstating asset demand.

[3] According to an article in *Defense Daily* (Biesecker, 2004),

> While the new systems being acquired under Deepwater would be substantially more capable than the legacy systems being retired, the original objective [of the Deepwater program] was to maintain the status quo in terms of overall capability, so fewer new assets would be needed . . . .

program other platforms and technologies that provide the same or additional capabilities.

So concludes this study, performed between November 2002 and summer 2003, of options open to the USCG as it pursues its Deepwater program, a multiyear effort to replace or modernize nearly 100 aging cutters and more than 200 aircraft. The study recommends that the USCG meet its mission demands by starting to accelerate and expand the asset acquisitions in the current Deepwater program and, at the same time, identifying and exploring new platform options, emerging technologies, and operational concepts that could leverage those assets. Such a two-pronged strategy may satisfy demand more quickly and at less cost than just expanding the original Deepwater plan.

The Problem

The existing Deepwater acquisition schedule, which calls for the USCG to acquire all of its new assets by the year 2022, was crafted in the late 1990s, long before the terrorist attacks of September 11, 2001. In the period since those attacks, the USCG has taken on expanded responsibilities in homeland defense and homeland security and has changed its institutional home to the newly created Department of Homeland Security.[4] Whether the original 20-year Deepwater acquisition schedule is still appropriate is an open question. However, the planned Deepwater force structure cannot do the job, and many members of Congress and other policymakers have suggested that the USCG rethink that acquisition timetable and the mix of assets it is planning to acquire. RAND's analysis—done at the request of the Program Executive Officer, Integrated Deepwater System—explored whether the USCG's original replacement and

[4] *Homeland security* encompasses missions that the USCG performs for DHS. *Homeland defense* encompasses missions the USCG performs for the Department of Defense (DoD). When the USCG engages in homeland defense, it can do so as either a supported or supporting commander for DoD.

modernization plan will allow it to adequately shoulder its traditional missions and emerging responsibilities[5] and identified ways it could, if necessary, adjust that plan.

The policy question RAND addressed was straightforward: Will the original Deepwater plan—drafted and initiated prior to the tragic events of September 11—provide the USCG with the right types and number of assets? On the one hand, the USCG has been asked to pursue its traditional missions more robustly,[6] with enhanced capabilities leading to improved operations utilizing fewer assets (USCG, 1996). On the other hand, it is being asked to perform, concurrently with its traditional missions, expanded homeland defense and homeland security responsibilities and to anticipate other, yet-to-be-identified, maritime responsibilities as the United States and its allies pursue the war against terrorism. The security environment since the events of September 11, 2001, has given new urgency to accelerating the acquisition of new assets.

What RAND Was Asked to Do About the Problem

The Deepwater Program Office asked the RAND Corporation to undertake two investigations:

- *Explore issues connected with speeding up, compressing, or otherwise accelerating the pace at which the USCG can acquire surface and air assets that it will operate in the deepwater environment.* As part of this examination, the RAND team was asked to look at the implications for force structure, performance, cost, and the in-

[5] As defined in *U.S. Coast Guard: America's Maritime Guardian* (U.S. Coast Guard [USCG], 2002c, pp. 62–63), *roles* are "the enduring purposes for which the USCG is established and organized." *Missions* are "the mandated services the Coast Guard performs in pursuit of its fundamental roles" and "tasks or operations assigned to an individual or unit." Note that the five USCG roles are also the USCG's five strategic performance goals (see Appendix A).

[6] The 1996 *Mission Need Statement for the Deepwater Capabilities Project* (USCG, 1996, p. 10) uses *robust* to mean "flexibility to use assets wherever need is greatest and guaranteeing that all assets are employed, even when not in service on primary mission."

dustrial base of commissioning all replacement assets, decommissioning all outmoded or old-technology (so-called legacy) assets, and completing all modernization tasks earlier than the year 2022.

- *Determine whether the original Deepwater plan would provide the USCG with a robust force structure to meet mission demands.* The RAND team was asked to evaluate the force structure that the original Deepwater acquisition plan would provide and define the boundaries of a force structure that would be large and flexible enough and with the capabilities to fulfill the USCG's traditional and emerging responsibilities.

Our charter was to explore and use information that was available on the capability of assets to meet demands for traditional missions and emerging responsibilities. We drew on information from two Center for Naval Analyses studies (Nordstrom and Partos, 2002; and East et al., 2000) as an order-of-magnitude baseline for our estimates. Those studies evaluated the demands for asset presence for traditional missions and emerging responsibilities. They are, by their own admission, limited because emerging responsibilities are still evolving. Therefore, this report cannot say: "This is exactly the force structure the U.S. Coast Guard will need." Rather, it provides an estimate of the force structure's magnitude.

How RAND Studied the Problem

RAND tackled the above two investigations using several interrelated methodologies.

With respect to issues connected with accelerating the acquisition schedule, RAND researchers

- identified ways that the USCG could accelerate or modify the Deepwater program acquisition plan so that the pace and range of assets it acquires allow it to more effectively accomplish both traditional missions and emerging responsibilities.[7]

To accomplish this examination, RAND employed an analytic approach that relied on three models: a force transition model, which examined performance[8] implications of acceleration; an industrial base model, which explored labor, capacity, competition, and other business issues associated with acceleration; and an operating and support cost model, which looked at the budget implications of alternative acquisition paths. RAND researchers populated these models with data—including information about the operational characteristics of USCG surface and air assets, their anticipated service lives, their manning requirements, and the anticipated labor, production, and cost issues associated with their replacements—provided by the USCG; other government agencies; Lockheed Martin and Northrop Grumman, the contractors managing Deepwater; other manufacturers of cutters and air vehicles; and independent research institutions. RAND researchers augmented these data with information obtained from a survey it sent to shipbuilders and aircraft makers seeking additional detailed program data about their workforces, workloads, production capacities, and facilities (provided in Appendix C). To glean further information, RAND researchers also conducted interviews with selected USCG leaders and industry representatives.[9]

The RAND team used all these quantitative and qualitative data to evaluate operational, performance, cost, and industrial base considerations surrounding three alternative timetables that the USCG

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[7] With regard to these responsibilities, a key phrase being used in the USCG community is Underway Dynamic Response Presence, which is what replacement assets should help guarantee.

[8] We evaluate *performance* in Chapter Three in terms of mission-hour and coverage-area capabilities. *Performance* is distinct from *effectiveness,* which can be thought of in terms of outcomes, such as tons of cocaine seized or arrests made.

[9] Data are always subject to change. For instance, the designs of many of the assets had not been finalized at the time of the study. However, the data we used were current at the time of the study.

could use to acquire Deepwater surface and air assets: the original 20-year schedule, a 15-year schedule, and a 10-year schedule.

With respect to issues connected with analyzing the Deepwater force structure, RAND researchers

- *explored asset-presence demands of traditional missions and emerging responsibilities:* the RAND team used as its starting point two recent studies done by the Center for Naval Analyses (CNA) that analyzed whether the USCG will be able to meet future demands for its services.[10] One study (East et al., 2000) looked at traditional demands being placed on the USCG's current assets. The other study (Nordstrom and Partos, 2002) looked at emerging demands that will require forces as the USCG moves into the twenty-first century and adjusts to its post–September 11 responsibilities. After reviewing CNA's calculations and performing an independent evaluation of its assumptions, the RAND team concurred with CNA's approaches and findings.
- *identified assets that the USCG would need to perform missions robustly:* RAND researchers made additional projections and evaluations, drawing from and building on the methodology and tools developed by CNA. In this portion of the analysis, RAND defined a force structure that the USCG would need to meet asset-presence demands for both traditional and emerging Deepwater responsibilities. The force structure needed to meet asset-presence demands takes into account both the number of assets that the USCG needs on-station for a particular responsibility and the number that are tied up in maintenance, modernization, training, and other duties. The RAND team used this concept to identify a force structure that would enable the USCG to provide 100-percent asset presence for traditional missions and emerging responsibilities, what we term a "100-Percent Force Structure."

[10] *Demands* are defined in terms of asset presence—i.e., a cutter or air vehicle on-station performing a mission.

- *assessed the costs and benefits of a force structure that provides 100-percent asset presence:* The RAND team compared its projected acquisition and operation and support costs for the above-identified force with those projected for the force acquired with the 20-year Deepwater plan. The study team also used operational projections to (1) examine performance improvements offered by accelerating or expanding the 20-year Deepwater acquisition program and (2) compare the number of ports that this force structure and the 20-year Deepwater force would be able to protect under highest-alert security conditions.
- *evaluated whether U.S. and allied manufacturers are capable of producing such a force:* Using data that shipbuilders and air vehicle manufacturers provided about their current and expected production capacities, RAND researchers evaluated, asset by asset, whether manufacturers will be able to accommodate this force's demand for surface and air assets.

Our Three Findings

Finding 1: The USCG can accelerate its acquisition of Deepwater assets.

Accelerating the acquisition from the original 20-year schedule to a 15- or 10-year timetable would have a negligible effect on total operating and support costs over a 20-year period, on annual operating and support costs, and on total acquisition costs.

Moreover, the shipbuilding and air vehicle industrial bases could produce the USCG's Deepwater assets on either the 15-year or the 10-year schedule. Manufacturers would require no major facility upgrades to accommodate acceleration. Northrop Grumman Ship Systems, which would build the National Security Cutter and Offshore Patrol Cutter, and the manufacturers of air assets would be able to accommodate faster acquisition timetables. Bollinger Shipyards, which is converting USCG patrol boats from 110-foot vessels to 123-foot vessels, would see its labor hours shrink by up to 4 percent if the acquisition schedule were compressed to 10 years; however, that reduction would be largely offset in the near term by accelerating the Fast Response Cutter.

By accelerating acquisition, the USCG would benefit from enhanced mission performance at an earlier date. We found that acquiring Deepwater assets over 15- or 10-year schedules would allow the USCG to operate surface and air assets for significantly more mission hours and to increase the detection coverage area for airborne sensors as compared with the capabilities it would acquire using a 20-year acquisition schedule. For instance, the total number of mission hours over a 20-year period would increase by 12 percent with the 15-year schedule and by 15 percent with the 10-year schedule. The total airborne sensor coverage area over a 20-year period would increase by 4 percent with the 15-year schedule and by 7 percent with the 10-year schedule.

Acceleration would have a negligible effect on total acquisition costs; however, it would result in increased annual outlays for acquisition. The average annual outlays (in FY1998 constant-year dollars) would increase from $400 million to $500 million under the 15-year plan and to $700 million under the 10-year plan. The peak annual outlay would increase from $600 million to $1 billion under the 15-year plan and to $1.3 billion under the 10-year plan.

Finding 2: Deepwater does not provide adequate numbers of surface and air assets for the USCG to meet asset-presence demands for traditional missions and emerging responsibilities at the 100-percent level.

The Deepwater program would acquire only half of the surface assets and two-thirds of the air assets required to meet the asset-presence demands of traditional missions and emerging responsibilities at the 100-percent level, a level that might well be the USCG's de facto mission-coverage standard in the post–September 11 environment. The United States today has a new image of its national interest, and policymakers should not assume that the USCG mission-coverage levels that were acceptable in the past will remain the same in the future.

Finding 3: To provide 100-percent asset presence for traditional missions and emerging responsibilities, the USCG will need the capabilities of twice the number of cutters and 50 percent more air vehicles than the original Deepwater plan provides.

The RAND team identified a force structure—dubbed the 100-Percent Force Structure—whose assets would enable the USCG to cover 100 percent of traditional and emerging mission demands for asset presence. Compared with the force structure that the USCG would acquire under the original 20-year acquisition schedule, this force structure would enable the USCG to operate its cutters for more mission hours and to have its air vehicles monitor more square miles. These benefits would begin to accrue as early as 2005 and exceed the original force structure's maximum performance by 2015. If it can couple this force structure with revised operational concepts that take greater advantage of unmanned air vehicles and flight deck–equipped cutters from which helicopters can be operated, the USCG would be able to protect more ports under highest-alert conditions.[11]

This force structure could be completely in place by 2027. It would cost roughly twice as much as the 20-year Deepwater acquisition plan to acquire and a third more to operate and support. Its total acquisition costs just for air and surface assets would come to $16.2 billion (in FY1998 dollars), not including costs associated with Integrated Logistics Support, USCG facilities upgrades, recruiting, or training. Its operating and support costs could hit $1.66 billion a year by 2027, more than double the $808 million that the 20-year Deepwater acquisition plan assets would require that year.

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[11] The highest Maritime Security Level alert condition is MARSEC III, which could last up to 15 days and is in response to specific intelligence that an incident/attack is imminent.

Policy Implications That Can Be Derived from Our Findings

We recommend that the USCG pursue a two-pronged strategy. The USCG should meet its mission demands and start replacing its aging assets by (1) accelerating and expanding the asset acquisitions in the current Deepwater program and, at the same time, (2) identifying and exploring new platform options, emerging technologies, and operational concepts that could leverage those assets. Such a two-pronged strategy may satisfy demand more quickly and at less cost than expanding the original Deepwater plan.

While we recommend that the USCG accelerate Deepwater and buy more assets than in the current plan, we also recommend that USCG leaders bear in mind that buying more of today's assets may not provide an optimal solution over the long term. To handle some of the responsibilities currently handled by traditional assets, the USCG could, for example, employ offshore rigs and airships, or realize emerging UAV concepts. Placing rigs near sea-lanes may enable the USCG to base and sustain surface and air assets in deepwater environments while lessening its traditional reliance on cutters.[12] Employing airships or relying more heavily on UAVs, particularly those able to stay aloft for long periods and to cover significant territory, may allow the USCG to enhance its surveillance, reconnaissance, and search and rescue capabilities. Such alternatives may involve less-costly assets than platforms the USCG currently uses to handle its responsibilities.

We provide a preliminary analysis of cost and performance for a 100-Percent Force Structure. Our analysis is sufficient for order-of-magnitude comparisons; however, more work would be required to produce budget-level cost estimates and analysis of operational effectiveness. Policymakers should use the order-of-magnitude estimates of the 100-Percent Force Structure as an upper bound against which

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[12] These are, of course, possible concepts of operation. Complete concepts of operations would have to be defined and the cost and feasibility of realizing those concepts examined before reliance on current assets is altered.

they can explore and evaluate alternative concepts and assets that provide the same or improved capabilities at less cost, rather than as a road map to pinpoint specific acquisition decisions.

With respect to accelerating Deepwater acquisitions, it should be noted that both of the acceleration schedules we examined—the 10-year and the 15-year—are feasible. However, to assess the ability of the USCG to integrate assets it would acquire using either of those schedules was beyond the scope of this study.[13] Without that assessment, we are reluctant to make a recommendation on whether to go with a 15-year or a 10-year acquisition schedule.

How and with what assets the USCG accomplishes traditional missions and emerging responsibilities is an open question. We have identified the force-structure capabilities that we believe the USCG will need in the future, but it is clear that the 100-Percent Force Structure we spell out is by no means the only way to reach those capabilities. However, relying on acquisitions spelled out in the Deepwater program, either in its original 20-year incarnation or in the 15-year and 10-year accelerations, will not provide the number and array of capabilities the USCG will need in the future.

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[13] By *integrate,* we mean providing the facilities, training, manpower, and other implications that such a force structure might require.

Acknowledgments

This work could not have been undertaken without the steadfast support and encouragement we received from Rear Admiral Patrick Stillman, USCG, Program Executive Officer, Integrated Deepwater System; Mr. Gregory Giddens, Deputy Program Executive Officer, Integrated Deepwater System; Captain R. R. Kelly, USCG, Sponsor's Representative, Deepwater Program; Captain Rick Yatto, USCG, Office of Transition Management; and Mr. Richard Ezzell, Chief, Resource and Metrics Management, Integrated Deepwater System; and members of their staffs. Many individuals in the USCG provided their time, knowledge, and information to help us perform the analyses discussed in this book. Their names and contributions would fill several pages.

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Abbreviations and Acronyms

AIS	Automatic Identification System
AMIO	Alien Migrant Interdiction Operations
AOR	Area of Responsibility
C4ISR	Command, Control, Communications, and Computers, Intelligence, Surveillance, and Reconnaissance
CD	Counterdrug
CNA	Center for Naval Analyses
CONOPS	Concept of Operations
DAFHP	days away from home port
Deepwater	Integrated Deepwater System (also IDS)
DHS	Department of Homeland Security
DOD	Department of Defense (also DoD)
DOT	Department of Transportation (also DoT)
DRUG	Drug Interdiction
EEZ	Economic Exclusion Zone
FDEC	Flight Deck–Equipped Cutter
FRC	Fast Response Cutter
HAE	High Altitude Endurance

HAEUAV	High Altitude Endurance Unmanned Air Vehicle
HEC	High Endurance Cutter (WHEC)
HITRON	Helicopter Interdiction Tactical Squadron
ICGS	Integrated Coast Guard Systems
IIP	International Ice Patrol
ILS	Integrated Logistics Systems
ISR	Intelligence, Surveillance, and Reconnaissance
LAB 2002	Legacy Asset Baseline 2002 Report
LMR	Living Marine Resource Enforcement
LRI	Long Range Interceptor
LRS	Long Range Search
LZE	Lightering Zone Enforcement
MARPOL	Maritime Pollution Enforcement
MARSEC III	highest maritime security alert level
MCH	Multimission Cutter Helicopter
MEC	Medium-Endurance Cutter (also WMEC)
MEP	Marine Environmental Protection
MHLS	Maritime Homeland Security
MIO	Maritime Intercept Operations
MOT	Military Ocean Transport
MPA	Maritime Patrol Aircraft
MSMP	Modeling and Simulation Master Plan [Report]
MSST	Maritime Security and Safety Team
nmi	nautical mile
NSC	National Security Cutter
O&M	operations and maintenance

OPC	Offshore Patrol Cutter
OPTEMPO	operational tempo
PACAREA	Pacific Area
PB	Patrol Boat (also WPB)
PSU	port security unit
PWC	personal watercraft
SIGINT	signals intelligence
SLE	service-life extension
SR	Search and Rescue
SRP	Short Range Prosecutor
TACLET	tactical law enforcement team
TOP	technical obsolescence prevention
UAV	unmanned air vehicle
USC	United States Code
USCG	United States Coast Guard
VRS	Vertical Recovery System
VUAV	Vertical Unmanned Air Vehicle
WAGB	Ice Breaker
WHEC	High Endurance Cutter (also HEC)
WIX	Training Cutter
WLB	Seagoing Buoy Tender
WLI	Inland Buoy Tender
WLIC	Inland Construction Tender
WLM	Coastal Buoy Tender
WLR	River Buoy Tender
WMEC	Medium Endurance Cutter (also MEC)
WPB	Patrol Boat (also PB)
WTGB	Ice Breaker Tug
WYTL	Small Harbor Tug

CHAPTER ONE

Introduction

Since it was established in 1790, the United States Coast Guard (USCG) and its predecessor agencies have been a military, multimission, maritime service (U.S. Coast Guard, 2002c, p. 1).[1] Although America's smallest armed service, the USCG is charged with a broad range of responsibilities for regulatory, law-enforcement, humanitarian, and emergency-response duties. These responsibilities expanded significantly after the terrorist attacks of September 11, 2001, and many observers predict that they will continue to expand as the USCG settles into its new organizational home in the Department of Homeland Security (DHS).[2]

Between November 2002 and summer 2003, RAND researchers analyzed options open to the USCG as it pursues a multiyear effort to

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[1] The USCG was established by an Act of Congress approved January 28, 1915. The Act consolidated the Revenue Cutter Service (founded in 1790) and the Life Saving Service (founded in 1848). The act of establishment stated that the USCG "shall be a military service and a branch of the armed forces of the USA at all times" (*Jane's Fighting Ships, 1996–97,* 1996, p. 848).

[2] H.R. 5005, the bill establishing the Department of Homeland Security, was passed by the Senate on November 19, 2002, and by the House on November 22, 2002. Section 888 transfers to DHS "the authorities, functions, personnel, and assets of the Coast Guard, which shall be maintained as a distinct entity" within DHS; preserves the USCG's missions, including its non–homeland security missions, along with the assets needed to perform those missions; stipulates that the Commandant of the USCG will report directly to the Secretary of DHS; and directs DHS to submit a report on the feasibility and potential implications of compressing procurement of the USCG's new Deepwater assets into a 10-year acquisition schedule instead of the original 20-year plan.

replace or modernize nearly 100 aging cutters[3] and more than 200 aircraft. Begun in 1996, the USCG's replacement and modernization effort, known as the Integrated Deepwater System program,[4] is intended to provide the USCG with state-of-the-art cutters, aircraft, and Command, Control, Communications, and Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) capabilities and modernized Integrated Logistics Systems (ILS) that will allow it to continue to perform missions in the deepwater environment,[5] well into the twenty-first century.

RAND's analysis—done at the request of the Program Executive Officer, Integrated Deepwater System—explored whether the USCG's original replacement and modernization plan will allow it to adequately shoulder both traditional missions and emerging responsibilities, and it identified ways in which USCG could, if necessary, adjust that plan. The question RAND addressed is stark: Will the original Deepwater plan—drafted and initiated before the tragic events of September 11—provide the USCG with the right types and number of assets? The USCG has been asked to pursue its traditional missions and emerging responsibilities and is being asked concurrently to perform expanded homeland security and defense missions and to anticipate other, yet-to-be-identified, maritime responsibilities as the United States and its allies pursue the war against terrorism.

RAND evaluated the number of cutters and aircraft in the USCG's current modernization and replacement plan to perform traditional and new deepwater missions and assessed ways to change the pace or character of modernizations and acquisitions should the need arise.

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[3] The USCG defines *cutter* as any vessel 65 feet in length or greater that has accommodations for crew to live on board. This definition includes high- and medium-endurance cutters, icebreakers, buoy tenders, and patrol boats. All USCG vessels under 65 feet in length are classified as *boats;* they typically operate near shore or on inland waterways. See Appendix A for a more complete definition of *cutter*.

[4] Throughout this document, we refer to the Integrated Deepwater System program as Deepwater.

[5] Roughly speaking, the *deepwater environment* is the waters more than 50 nautical miles from shore.

Background

The Deepwater program will be the largest and most complex acquisition effort in USCG history. The USCG expects that the program will make it both more efficient as it pursues traditional roles and better able to accomplish traditional missions and emerging responsibilities. As such, it is considered central by the USCG's leadership to the service's ability to perform operations in the future (O'Rourke, 2003, p. 1).

The USCG has been explicit in detailing its reasoning behind the need for modernizations and replacements and its operational expectations for the new assets. On its public website (*http://www.uscg.mil/deepwater/*), for example, it states the following:

> Many of the Coast Guard's most critical missions—countering terrorist threats, rescuing mariners in distress, catching drug smugglers, stopping illegal migrants, and protecting the marine environment—demand forces that are able to operate effectively across a broad geographic spectrum, from overseas operating areas to U.S. Exclusive Economic Zone, coastal, and port regions. The Coast Guard's Deepwater cutters and aircraft are designed to operate throughout these diverse environments. They comprise the first line of the Service's layered defense against threats to America's homeland and maritime security.
>
> Unfortunately, the Service's current Deepwater assets are aging and technologically obsolete. They lack essential speed, interoperability, sensor and communication capabilities, which in turn limit their overall mission effectiveness and efficiency. To address these shortfalls, the Coast Guard established the Integrated Deepwater System Program to replace and modernize its aging force of cutters and aircraft, and their supporting command-and-control and logistics systems. These new assets, which possess common systems and technologies, common operational concepts, and a common logistics base[,] will give the Coast Guard a significantly improved ability to detect and identify all activities in the maritime arena, a capability known as "maritime domain awareness," as well as the improved ability to intercept and en-

> gage those activities that pose a direct threat to U.S. sovereignty and security.
>
> The Coasts Guard's Deepwater Program will ensure that the Coast Guard—and the nation—has cutters, aircraft, and command-and-control systems that can capably defend against maritime threats far out to sea, before they can reach U.S. citizens, territory, or vital interests. The Integrated Deepwater System is critical to the Coast Guard's future and to America's ability to safeguard homeland and maritime security for generations to come.

Deepwater also will have an impact on the USCG's near-shore operations. All or nearly all of the assets the USCG plans to acquire through the program can be assigned to duties closer to shore than 50 nautical miles should the need arise—for example, coastal waters, harbors, inland rivers, and the Great Lakes.[6] Fully implemented, the program will encompass three classes of new cutters and associated small boats, new fixed-wing manned aircraft, new and upgraded helicopters, and cutter- and land-based unmanned air vehicles (UAVs). These assets will be linked with C4ISR systems and supported by an ILS (*http://www.uscg.mil/deepwater/*).

From the beginning of the Deepwater program, the USCG intended that a single contractor would oversee and integrate the effort's components. Such a contract was awarded in June 2002 to Integrated Coast Guard Systems (ICGS), a joint venture established by Lockheed Martin and Northrop Grumman. In awarding the contract, the Department of Transportation and the USCG said that Deepwater has the potential to extend up to 30 years and has an approximate value of $17 billion (*http://www.uscg.mil/deepwater/*).

[6] Note that all of the emerging responsibilities have yet to be defined clearly.

Sources of Evidence We Drew on to Address the Study Question

The study team began by reviewing whether and to what degree the homeland defense and homeland security environment in which the USCG operates has changed since September 11. This step involved reviewing the USCG's traditional missions and examining calls made by Congress and other policymakers to change or broaden those missions in light of new threats and responsibilities.

Once the study team had identified the USCG's range of post–September 11 responsibilities, it evaluated whether the replacement assets spelled out in the Deepwater program's original acquisition plan will allow the USCG to accomplish traditional missions and emerging responsibilities over the next two decades. In this part of our analysis, we reviewed two reports produced by the Center for Naval Analyses (CNA):

- James R. East, Alarik M. Fritz, Steven W. Klein, and Kent B. Nordstrom, *U.S. Coast Guard Deepwater Missions: Current and Projected Requirements and Capabilities,* Alexandria, Va.: Center for Naval Analyses, CNA Research Memorandum CRM D0000204.A3, September 2000.
- Kent B. Nordstrom and Dana S. Partos, *Impact of Post-1998 USCG Deepwater Mission Demands,* Arlington, Va.: Center for Naval Analyses, CNA Research Memorandum CRM D0007250.A2/Final, December 2002.

RAND's charter was to explore and use what information was available on the capability of assets to meet demands for traditional missions and emerging responsibilities. We drew on information from two CNA reports as an order-of-magnitude baseline for our estimates, even though those studies are, by their own admission, limited because responsibilities for emerging missions have yet to be defined. Therefore, this report cannot say: "This is exactly the force structure the U.S. Coast Guard will need." Rather, it provides an estimate of the force structure's magnitude.

Our evaluation of ways that the USCG could accelerate or modify the Deepwater program acquisition plan was informed by data provided by the Deepwater Program Office, by the contractors overseeing Deepwater, and by manufacturers of surface and air assets.

Report Organization

This report is organized in five chapters. Following this introduction, Chapter Two describes the USCG today, the Deepwater program as it is currently configured, and emerging homeland defense and homeland security missions. The implications of accelerating the Deepwater acquisition schedule are explored in Chapter Three. That discussion is followed in Chapter Four with an exploration of the assets needed to meet presence demands for traditional missions and emerging responsibilities. Chapter Five provides conclusions and recommendations.

CHAPTER TWO

The Coast Guard and Deepwater Today

Charged both with a broad scope of regulatory, law-enforcement, humanitarian, and emergency-response duties and with a compelling national defense role as one of the five U.S. Armed Services, the USCG is a unique federal agency.[1] During peacetime, it typically operates as an arm of a nondefense U.S. federal agency. At times during the past 100 years, the USCG was associated with the Department of the Treasury and the Department of Transportation.[2] In March 2003, it moved to a new peacetime organizational home, the Department of Homeland Security (DHS). During wartime, the USCG falls under the direction of the Secretary of the Navy, a reassignment that can take place either when war has been declared or when the President orders a revamped command structure.

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[1] Title 14 of the United States Code (U.S.C.) defines and tasks the U.S. Coast Guard. In 14 U.S.C. 1, the U.S. Coast Guard is defined as ". . . a military service and branch of the armed forces of the United States at all times." In 14 U.S.C. 2, it is directed to

> . . . enforce or assist in the enforcement of all applicable Federal laws on, under, and over the high seas and waters subject to the jurisdiction of the United States . . . administer laws and promulgate and enforce regulations for the promotion of safety of life and property on and under the high seas and waters subject to the jurisdiction of the United States . . . and . . . maintain a state of readiness to function as a specialized service in the Navy in time of war, including the fulfillment of Maritime Defense Zone command responsibilities.

[2] The USCG has also been associated with the Department of Commerce, for lighthouse service.

The USCG is the lead federal agency for maritime homeland security and has been since its inception. It operates in a complex and dangerous maritime environment defined by rapidly changing security threats. In addition to missions at home, it conducts missions abroad with the U.S. Navy and with other nations' coast guards in support of National Defense Policy.

USCG Missions and Responsibilities

According to the USCG official website (*http://www.uscg.mil/USCG.shtm,* accessed September 23, 2003), USCG is involved in the following missions in both areas of responsibility, under its five roles:[3]

Maritime Safety

- Search and rescue
- Marine safety
- Recreational boating safety
- International Ice Patrol.

Maritime Mobility

- Aids to navigation
- Icebreaking services
- Vessel traffic/waterways management
- Bridge administration
- Rules of the road.

[3] The subset of USCG missions to be considered in an assessment of the operational effectiveness of the Integrated Deepwater System is found in Section E.2 of U.S. Coast Guard, Deepwater Program Office (G-D*), Modeling and Simulation Master Plan (MSMP),* Version 2.0, Washington, D.C., October 4, 2002b.

Maritime Security

- Drug interdiction
- Alien migrant interdiction
- EEZ [Economic Exclusion Zone] and living marine resource
- General maritime law enforcement
- Law/treaty enforcement.

National Defense

- General defense duties
- Homeland security
- Port and waterways security
- Polar icebreaking.

Protection of Natural Resources

- Marine pollution education, prevention, response, and enforcement
- Foreign vessel inspections
- Living marine resources protection
- Marine and environmental science.

The USCG website includes web pages for each mission. In Appendix A, we include short descriptions of the responsibilities associated with each mission from the *Mission Need Statement* (USCG, 1996). Note that, in 1996, there were only four roles: Maritime Law Enforcement, Maritime Safety, National Defense, and Marine Environmental Protection. One of the new missions listed in that document, Environmental Defense Operations (now Military Environmental Response Operations), was awaiting definition of responsibilities/requirements, although partial requirements were presented. This responsibility gives an example of how complex the definition of all needed capabilities and assets can be (USCG, 1996, p. 8):[4]

> Requirements are yet to be determined[;] however interoperability and ability to transport crews to the scenes of environmental incidents are certain requirements. Some oil spill or containment capability will also likely be a requirement.

The Homeland Security Act of 2002 established a Department of Homeland Security, as an executive department of the United States. The USCG is under the direction of the Department of Homeland Security in peacetime and under the direction of the Secretary of the Navy in wartime. As a result, missions are grouped according to those pertaining to homeland security and those that are non–homeland security:

Homeland Security

- Drug interdiction
- Migrant interdiction
- Other law enforcement
- Defense readiness
- Ports, waterways, and coastal security.

Non–Homeland Security

- Search and rescue
- Marine safety
- Marine environmental protection
- Living marine resources protection

[4] USCG's website (*http://www.uscg/mil*) gives a good example of how one responsibility in one mission supports responsibilities in other missions, although there does seem to be quite a bit of overlap.

- Aids to navigation
- Ice operations (international ice patrol, polar and domestic icebreaking.

However, missions are not necessarily discrete. Migrant interdiction (which is under Homeland Security) may involve responsibilities under the search and rescue mission (which is under Non–Homeland Security) because of the poor condition of the watercraft often used by migrants. Likewise, both law and treaty enforcement may involve protecting living marine resources. As well, since homeland security is a new department, some of the missions for which it is responsible may have yet to be defined.

Areas of Responsibility

The USCG's areas of responsibility and its surface and air assets can be divided into coastal (within 50 nmi of shore), deepwater (50 nmi or more off shore), inland waters, and polar areas.

USCG personnel and assets are organized geographically around two major commands, Atlantic Area and Pacific Area, each of which is headed by a vice admiral who directs and oversees all USCG missions in his or her respective geographical area. As shown in Figure 2.1, these area commands are further organized into a total of nine district commands. Each district command is headed by a rear admiral. These districts, in turn, are assigned a number of subordinate operational units: groups, stations, marine safety offices, activities, air stations, aids-to-navigation teams, and vessel traffic services. Major cutters (High Endurance Cutters, Medium Endurance Cutters, and Polar Icebreakers) are assigned to the two areas, but they conduct their missions, for the most part, under district operational control. Patrol Boats are group assets.[5] Area commands also oversee tactical

[5] Coastal Patrol Boats (87-foot) are group assets, and Buoy Tenders are district units. However, we limit our discussion of asset oversight to assets operating in the deepwater environment.

law enforcement teams (TACLETs), port security units (PSUs), Maritime Security and Safety Teams (MSSTs), and the Helicopter Interdiction Tactical Squadron (HITRON); however, the area commands assign these specialty units to the districts for operational missions (U.S. General Accounting Office, 2002, p. 5).

The groups, which conduct almost all USCG missions, are assigned stations (with their motor lifeboats and utility boats), Coastal Patrol Boats, aids-to-navigation teams, and certain Buoy Tenders. However, groups tend to concentrate on personal watercraft (PWC) patrol, search-and-rescue, maritime law enforcement, aids-to-navigation, and national defense missions in their respective locations, which are usually along the coast and in the ports. Marine safety offices, with their captain-of-the-port responsibilities, are in

Figure 2.1
USCG Commands and Units

SOURCE: http://www.uscg.mil/units.html
RAND MG114-2.1

charge primarily of the USCG's marine safety, port security, and marine environmental protection missions. They are located in the coastal ports and on inland waterways. Activities commands are the complete integration of a marine safety office and group into a single unit at one location.

USCG Current Assets

To accomplish the varying missions and responsibilities outlined above, the USCG operates a variety of High Endurance Cutters and Medium Endurance Cutters (U.S. General Accounting Office [GAO], 2002, p. 5), Patrol Boats, and aircraft, as summarized in Table 2.1.

Table 2.1
USCG Deepwater Assets, 2002

Fleet	Number	Description
Surface Ships		
378-foot High Endurance Cutter HEC-378, Hamilton class	12	This is the largest multipurpose cutter in the fleet. It has a planned crew size of 167, a speed of 29 knots, and a cruising range of 14,000 nmi. USCG operates it for about 185 days a year, and it can support helicopter operations.
270-foot Medium Endurance Cutter MEC-270, Famous class	13	This cutter has a planned crew size of 100, a speed of 19.5 knots, and a cruising range of 10,250 nmi. The Coast Guard operates it for about 185 days a year, and it can support helicopter operations.
210-foot Medium Endurance Cutter MEC-210, Reliance class	14	This cutter has a planned crew size of 75, a speed of 18 knots, and a cruising range of 6,100 nmi. The Coast Guard operates it for about 185 days a year, and it can support operations of Short Range Recovery Helicopters.
110-foot Patrol Boat PB-200, Island class	49	This Patrol Boat has a planned crew size of 16, a speed of 29 knots, and a cruising range of 3,928 nmi. The Coast Guard operates most of these craft for about 1,800 hours (hr) a year.
Total[a]	88	
Aircraft		
HC-130 Long Range Surveillance Aircraft	27	This is the largest aircraft in the Coast Guard's fleet. It has a planned crew size of seven, a speed of 290 knots, and an operating range of about 2,600 nmi. The Coast Guard operates most of these aircraft for about 800 hr every year.
HU-25 Medium Range Surveillance Aircraft	25	This is the fastest aircraft in the Coast Guard's fleet. It has a planned crew size of five, a speed of 410 knots, and an operating range of 2,045 nmi. The Coast Guard generally operates these aircraft for about 800 hr a year.
HH-60J Medium Range Recovery Helicopter	42	This helicopter is capable of flying 300 miles off shore, remaining on scene for 45 minutes (min), hoisting six people on board, and returning to its point of origin. The Coast Guard operates most for about 700 hours a year. It has a planned crew size of four, a maximum speed of 160 knots, and a maximum range of 700 nmi.
HH-65 Short Range Recovery Helicopter	95	This helicopter is capable of flying 150 miles off shore. It has a crew allowance of three, a maximum speed of 165 knots, a maximum range of 400 nmi, and a maximum endurance of 3.5 hr. The Coast Guard operates most for about 645 hr a year.
Total[b]	189	

SOURCES: Data are from O'Rourke, 2003; Nordstrom and Partos, 2002; U.S. GAO, 2002, p.6.

[a]Does not include icebreakers or buoy tenders but does include a 213-foot Medium Endurance Cutter that was commissioned in 1944, a 230-foot Medium Endurance Cutter that was commissioned in 1942, and a 282-foot Medium Endurance Cutter that was commissioned in 1999, following 26 years in service with the U.S. Navy.

[b]Does not include three support aircraft (VC-4, C-20, and C-37) and eight leased MH-68A helicopters used in support of the counterdrug mission.

The Deepwater Program Today

While it carries out many responsibilities within U.S. coastal and inland waters, the USCG performs a number of statutorily mandated missions in the deepwater environment, waters generally 50 or more nautical miles from shore. Indeed, some of these deepwater missions take place far from U.S. territory and require continuous on-scene presence (O'Rourke, 2003, p. 2).[6]

Table 2.2 depicts the assets that the Deepwater program as currently configured will acquire.

The assets that Deepwater will acquire will not be one-for-one replacements for the USCG's current inventory of cutters and aircraft that operate in deepwater environments. Figure 2.2 shows the correspondence between the current and planned assets.

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[6] For more information on the USCG and homeland security and defense, see O'Rourke (2002).

Table 2.2
USCG Deepwater Program Replacement Assets, 2002–2022

Fleet	Number	Description
Surface Ships		
421-foot National Security Cutter (NSC)	8	Planned crew size of 82, top speed of 28 knots, cruising range of 12,000 nmi. Capable of operating two helicopters *or* one helicopter and 2 VSTOL UAVS (VUAVs) *or* 4 VUAVs. The USCG will be able to operate it about 233 underway days per year using a crew rotation scheme.[a]
341-foot Offshore Patrol Cutter (OPC)	25	Planned crew size of 84, top speed of 22 knots, cruising range of 9,000 nmi. Capable of operating two helicopters *or* one helicopter and 2 VUAVs *or* 4 VUAVs. The USCG will be able to operate it about 220 underway days per year using a crew rotation scheme.[a]
130-foot Fast Response Cutter (FRC)	58	Planned crew size of 15, top speed 30 knots, cruising range of 4,200 nmi. The USCG will be able to operate it about 123 underway days per year.[a]
Total	91	
Aircraft		
CASA 235 Maritime Patrol Aircraft (MPA)	35	Planned crew size of four, maximum speed of 230 knots, operating range of 3,100 nmi. Its expected availability is 80% (292 days per year), operated 1,200 hr annually.
Long Range Search (LRS)	6	This is an update of the HC-130. Maximum speed is 320 knots, and operating range is 4,100 nmi. Its expected availability is 75% (274 days per year), operated 900 hr annually.
High Altitude Endurance UAV (HAEUAV)	7	This is a USCG version of the Global Hawk UAV. It operates at 340 knots, with operating range of 12,500 nmi. Its expected availability is 96%, operated 2,300 hr annually.[a]
AB-139 helicopter Vertical Recovery System (VRS)	34	Agusta/Bell helicopter. Maximum speed is 170 knots; operating range is 500 nmi. Its expected availability is 80% (292 days per year), operated 800 hr annually.
HH-65 Upgrade Multimission Cutter	93	Maximum speed is 170 knots, and operating range is 420 nmi. Its expected availability is 80% (292 days per year), operated 700 hr annually.
VSTOL UAV (VUAV)	69	Maximum speed is 220 knots; operating range is 750 nmi. Its expected availability is 85% (310 days per year), operated 1,200 hr annually.
Total	244	

SOURCES: Data are from O'Rourke (2003, p. 3); Nordstrom and Partos (2002); USCG (2002a)

[a]This information is from Nordstrom and Partos (2002, p. 28).

Figure 2.2
USCG Legacy Assets Replaced, Converted, Retained, and Added in Deepwater Acquisition Program

Legacy		Deepwater		
Assets	Number	Assets	Number	
W High Endurance Cutters	12	National Security Cutter (NSC)	8	Surface
W Medium Endurance Cutters	32	Offshore Patrol Cutter (OPC)	25	Surface
W Patrol Boats	49	Fast Response Cutter (FRC)	58	Surface
HC-130 HU-25	11 27	Maritime Patrol Aircraft (MPA)	35	Air
HC-130	13	High Altitude Endurance Unmanned Air Vehicle (HAEUAV)	7	Air
HC-130	6	Long Range Surveillance (LRS) (LRS are renamed HC-130)	6	Air
HH-60	42	Vertical Recovery System	34	Air
HH-65	93	Multimission Cutter Helicopter (MCH)	93	Air
		Vertical Unmanned Air Vehicle (VUAV)	69	Air

Legend: Replace / Convert / Retain / Add

NOTE: The letter *W* designates a USCG vessel. See Appendix A for a further discussion of cutters.
RAND *MG114-2.2*

Deepwater Timeline

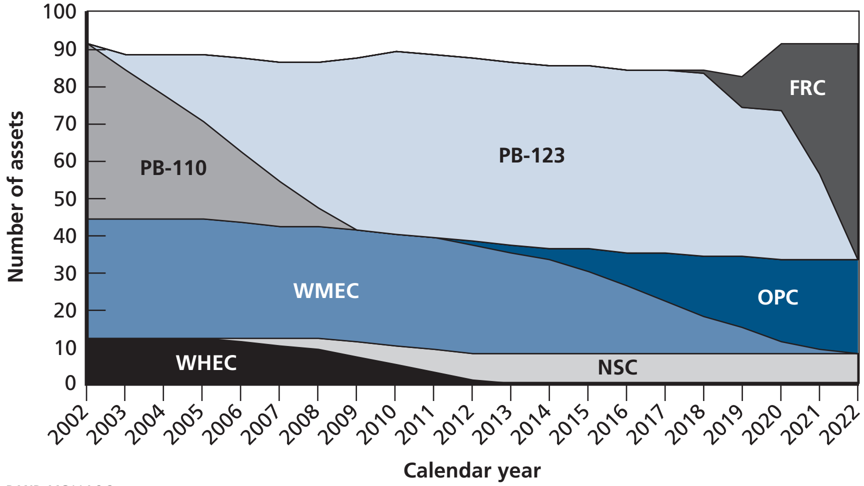
Deepwater assets will be acquired over the next 20 years. Table 2.3 and Figure 2.3 show the number of surface assets in service in each year under the Deepwater 20-year acquisition schedule. Similarly, Table 2.4 and Figure 2.4 show the number of air assets in service in each year under the original 20-year Deepwater acquisition schedule.

Table 2.3
Number of Surface Assets in Service at End of Calendar Year, Deepwater 20-Year Acquisition Schedule

Year	WHEC	NSC	WMEC	OPC	PB-110	PB-123	FRC	LRI[a]	SRP[a]
2002	12	0	32	0	47	0	0	0	0
2003	12	0	32	0	40	4	0	0	4
2004	12	0	32	0	33	11	0	0	11
2005	12	0	32	0	26	18	0	0	18
2006	11	1	31	0	19	25	0	1	26
2007	10	2	30	0	12	32	0	2	34
2008	9	3	30	0	5	39	0	3	42
2009	7	4	30	0	0	46	0	4	50
2010	5	5	30	0	0	49	0	5	54
2011	3	6	30	0	0	49	0	6	55
2012	1	7	29	1	0	49	0	8	57
2013	0	8	27	2	0	49	0	10	59
2014	0	8	25	3	0	49	0	11	60
2015	0	8	22	6	0	49	0	14	63
2016	0	8	18	9	0	49	0	19	64
2017	0	8	14	13	0	49	0	25	66
2018	0	8	10	16	0	49	1	30	68
2019	0	8	7	19	0	40	8	35	76
2020	0	8	3	22	0	40	18	37	81
2021	0	8	1	24	0	23	35	40	82
2022	0	8	0	25	0	0	58	42	82

[a]Long Range Interceptors (LRIs) and Short Range Prosecutors (SRPs) are not included in Figure 2.3.

Figure 2.3
Number of Surface Assets in Service at End of Calendar Year, Deepwater 20-Year Acquisition Schedule

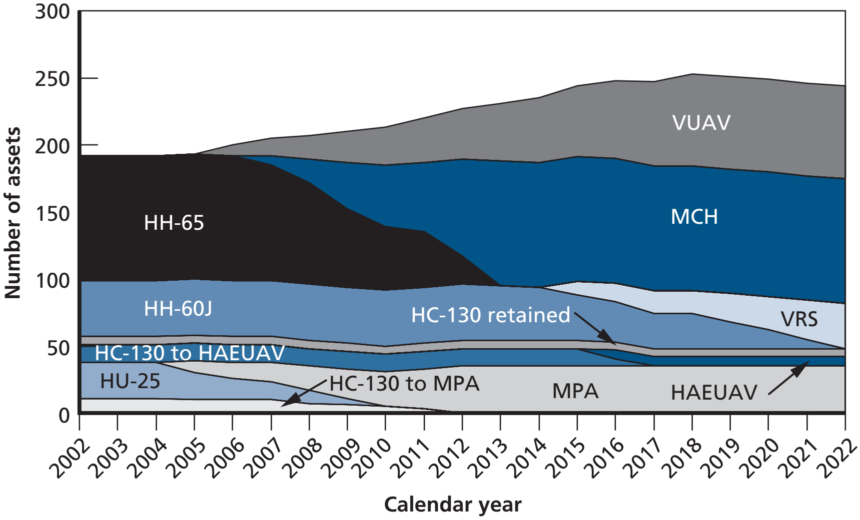


RAND *MG114-2.3*

Table 2.4
Number of Air Assets in Service at End of Calendar Year, Deepwater 20-Year Acquisition Schedule

Year	HC-130	HH-60J	HH-65	HU-25	VRS	VUAV	MPA	MCH	HAEUAV
2002	30	42	93	27	0	0	0	0	0
2003	30	42	93	27	0	0	0	0	0
2004	30	42	93	27	0	0	0	0	0
2005	29	42	93	20	0	0	9	0	0
2006	29	42	93	16	0	8	12	0	0
2007	29	42	86	13	0	13	15	7	0
2008	26	42	76	10	0	18	18	17	0
2009	25	42	58	5	0	23	22	35	0
2010	24	42	47	0	0	28	26	46	0
2011	22	42	41	0	0	33	30	52	0
2012	19	42	21	0	0	38	35	72	0
2013	19	41	0	0	0	43	35	93	0
2014	19	40	0	0	0	48	35	93	0
2015	19	34	0	0	10	53	35	93	0
2016	11	30	0	0	14	58	35	93	7
2017	6	26	0	0	17	63	35	93	7
2018	6	26	0	0	17	69	35	93	7
2019	6	20	0	0	21	69	35	93	7
2020	6	14	0	0	25	69	35	93	7
2021	6	7	0	0	29	69	35	93	7
2022	6	0	0	0	34	69	35	93	7

Figure 2.4
Number of Air Assets in Service at End of Calendar Year, Deepwater 20-Year Acquisition Schedule



RAND *MG114-2.4*

CHAPTER THREE

What Are the Implications of Accelerating Deepwater Acquisition?

USCG's existing Deepwater acquisition schedule, which calls for the USCG to acquire all of its new assets by the year 2022, was crafted before the terrorist attacks on the World Trade Center and the Pentagon. Since those events, the USCG has taken on expanded roles in homeland defense and homeland security and has changed its institutional home to the newly created Department of Homeland Security.

Whether the original 20-year Deepwater acquisition schedule is appropriate for these new conditions is an open question, and many members of Congress and other policymakers have suggested that the USCG rethink that acquisition timetable, which was intended to slowly, but steadily, modernize the USCG fleet, and expand and accelerate the program.[1] This chapter explores issues connected with speeding up, compressing, or otherwise accelerating the pace at which the USCG can acquire surface and air assets that it will operate in the deepwater environment. It looks at the force structure, cost, performance,[2] and industrial-base implications of commissioning all replacement assets, decommissioning all legacy assets, and completing all modernization tasks earlier than the year 2022.

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[1] "Senate Governmental Affairs Committee Chairwoman Susan Collins (R-ME) and Ranking Member Joseph Lieberman (D-CT) . . . urged the Bush administration to increase fiscal year 2005 funds to accelerate the revamping of the Coast Guard's aging fleet" ("Senators Urge White House to Speed Up Deepwater," 2003).

[2] "While the new systems being acquired under Deepwater would be substantially more capable than the legacy systems being retired, the original objective was to maintain the status quo in terms of overall capability, so fewer new assets would be needed . . ." (Biesecker, 2004).

RAND'S Questions

Why look at acceleration? Two factors motivated our exploration of the implications of accelerating Deepwater. The first has to do with growing costs associated with operating aging assets. Some existing Deepwater assets were designed in the 1950s and were commissioned in the early 1960s.[3] As they have aged, they have become more expensive to operate, difficult to support, have major materiel-readiness problems, and, in some cases, are prohibitively costly to modernize. Some HEC-378s and MEC-210s are in such bad materiel condition that, even after they have undergone a service-life extension (SLE) program, they continue to have materiel problems and cannot perform efficiently, if at all.[4] Accelerating acquisition would allow the USCG to benefit sooner both from the improved efficiency of the replacement assets and from lower operating and support costs, and may result in fewer efforts to extend the lives of those assets than it currently plans.

The second motivating factor has to do with enhanced mission performance of the replacement assets. The Deepwater system should perform more reliably and effectively than the aging legacy assets it replaces. Many policymakers speculate that, by accelerating Deepwater, the USCG would benefit from enhanced mission performance at an earlier date.

Given these two motivating factors underlying acceleration, RAND developed the following four research questions:

- Can acquisition of Deepwater assets be accelerated?
- What are the performance implications of acceleration?

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[3] The cutters *Storis* and *Acushnet* were commissioned during WWII. However, to assign age according to commissioning is misleading, because these assets have been modified. For instance, *Acushnet* was upgraded and converted to a Medium Endurance Cutter in 1978.

[4] Personal communication with a senior USCG officer, November 2003.

- What are the cost implications of acceleration?
- What are the industrial-base implications of acceleration?

Data Sources and Methodology

RAND used multiple data sources and a variety of analytic tools to answer the four questions spelled out immediately above.

Data We Relied On

Data provided by the USCG, ICGS, and manufacturers were the primary sources for acquisition, operating, and support costs. ICGS provided official cost estimates for Deepwater's contract and non-contract government-incurred expenses. This information was categorized according to five phases in the life of each USCG asset: design, production, operations and maintenance (O&M), service-life extension, and disposal (Integrated Coast Guard Systems, 2002). The data provide annual cost streams for individual assets in fixed-year, 1998 dollars. The Deepwater Program Office and manufacturers provided additional information, which we used to check, confirm, and augment these ICGS data (U.S. Coast Guard, 2002a, b).

CNA provided other information related to asset performance (Nordstrom and Partos, 2002).

The major manufacturers of Deepwater replacement assets shared information related to the shipbuilding and air-vehicle industrial bases. We asked each shipbuilder and air-vehicle manufacturer listed in Appendix B to complete a survey containing detailed questions about their current labor force, availability of workers, overhead rates, production schedules (for Deepwater and non-Deepwater work), facilities requirements, capacity, lead times, cost impacts associated with acceleration schemes (such as reductions in overhead rates due to a larger business base or extra costs of hiring and training additional workers), and other relevant information. The survey is included as Appendix C. RAND met with each manufacturer of cutters and aircraft to obtain additional information through interviews.

RAND gathered data to estimate two broad categories of costs: acquisition and operating and support. Acquisition-cost estimates are intended to reflect the total government-incurred costs of acquiring assets, including the design, production, technical obsolescence prevention (TOP), and SLE costs. Estimates of operating and support costs are intended to reflect the costs of operating personnel, energy, maintenance and repair, and supplies (a more detailed breakdown is given in Table 16 of the Legacy Asset Baseline (LAB) report [USCG, 2002a]). To estimate the acquisition costs for the 20-year Deepwater acquisition schedule, RAND used the sum of SLE, design, and production-phase costs developed by ICGS (2002). To estimate operating and support costs for that 20-year timetable, the RAND team used the sum of O&M and disposal-phase costs from ICGS.

Crewmembers of surface assets are inherently tied to the surface assets that they operate. For this reason, the ICGS O&M cost–phase data for surface assets include the costs for operating personnel. The operators of air assets are not as closely tied to specific assets. As a result, the ICGS O&M cost–phase data for air assets do not include the costs for operating personnel. RAND obtained cost information for operating personnel of air assets from the USCG and added them to the O&M costs.[5] In summary, RAND's estimates of operating and support costs include the cost of operating personnel.

Analytic Tools We Used

We used the above data to populate multiple models, some of which were developed on previous RAND studies and were modified for this study, others of which were newly developed. In some cases, we modeled air and surface assets separately, with differing tools, and combined the results. Three of the main models we used were the Force Transition Model, the Industrial Base Model, and the Operating and Support Cost Model, which are described below. We also

[5] Data were provided by LCDR Scott Craig, Aircraft OE Funds Manager, USCG.

developed several integrating tools that allowed us to combine and aggregate the output of these models.

Force Transition Model. The Force Transition Model enabled RAND to determine which assets can be accelerated. It is a spreadsheet tool that tracks the commissioning and decommissioning dates of assets. We used this tool to coordinate the acquisition schedules of each asset class, synchronize decommissioning of legacy assets with their replacements' commissioning, and track total platform counts.

Industrial Base Model. This model permitted RAND to evaluate various labor, capacity, competitive, and other business implications of acceleration. It relied on optimization tools that RAND researchers developed in earlier studies (Birkler et al., 1998, 2002). Those tools allowed us to identify costs arising from labor turbulence at shipyards. The tools minimize excess capacity in labor supply, subject to several constraints: labor demand, labor availability, training requirements, and attrition rates. The RAND team augmented these shipyard-labor data with information that compared Deepwater's planned production and lead-time schedules with lead-time and production constraints identified by the asset manufacturers. From this information, the RAND team was able to estimate the acquisition cost for each asset in the Deepwater plan.

Operating and Support Cost Model. This model allowed us to compare operating and support costs associated with the various mixes of legacy and Deepwater assets that different acquisition schedules would produce.

How We Employed the Data and Models

Using the above data and models, we compared the costs of acquiring Deepwater assets over 20, 15, and 10 years. In some cases, we modeled acquisition costs at the individual-asset level, rather than at the asset-class level, depending on how the acquisition costs observed in the data for the original Deepwater acquisition schedule varied. These cost calculations included the effects of learning curves—derived from the manufacturers, ICGS, and RAND data sets—that we identified for each asset.

Separately, we estimated the operating and support cost streams for each Deepwater asset as a function of the asset's being acquired over 20, 15, or 10 years. When costs for assets within a class varied little, we used a common operating and support cost stream for that entire class; when they varied significantly, we modeled them individually. We then aggregated these individual costs to estimate a total operating and support cost for each schedule.

Assumptions and Caveats

Our analysis was conditioned on five assumptions and one caveat, as spelled out below.

Assumption 1: Constant-year dollar analysis will be used in this study. Specifically, costs will be estimated in 1998 constant-year dollars. This assumption makes our study's figures consistent with the dollars used in multiple earlier analyses (East et al., 2000; Nordstrom and Partos, 2002; USCG, 2002a). Doing so also is in keeping with an Office of Management and Budget (OMB, 1992) recommendation that analysts avoid making an assumption about the general rate of inflation whenever possible and that all benefit-cost analysis for the government be accomplished using constant-year dollar values.

Also, we specified annual cost estimates in calendar years (as opposed to fiscal years). The ICGS data we relied on contain annual cost estimates specified in calendar years, and we followed that convention in this report.

Assumption 2: Annual acquisition and operating and support cost streams for accelerated acquisition schedules will not be capped. The acquisition cost stream was capped at roughly $500 million (FY1998 dollars) annually for Deepwater programming. Similarly, the operating and support cost stream was capped at roughly $1 billion (FY1998 dollars) annually for Deepwater programming. The RAND team did not place caps on the acquisition and operating and support cost streams associated with the accelerated acquisition schedules; instead, it let the annual spending levels float as free variables and estimated what the acquisition and operating and support caps would have to be under each acceleration plan it developed.

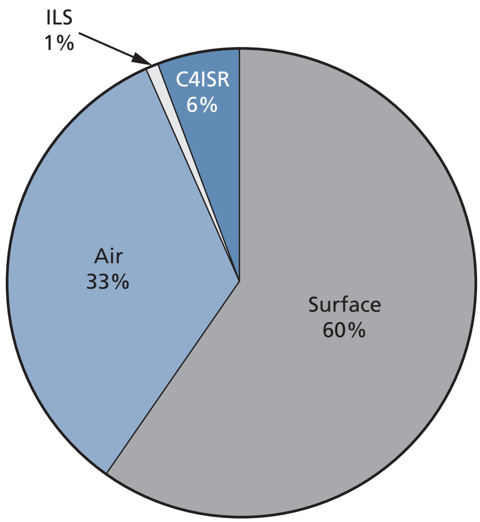
Assumption 3: There are no cost, performance, or industrial-base implications of accelerating the acquisition of Long Range Interceptor (LRI) and Short Range Prosecutor (SRP) assets. This assumption is justified, since both assets are inexpensive to acquire and operate compared with the National Security Cutter, Offshore Patrol Cutter, and Fast Response Cutter.

Caveat: RAND focused attention on the impacts of accelerating the acquisition of surface and air assets only, even though Deepwater entails the acquisition of surface, air, and C4ISR assets, and the modernization of Integrated Logistics Systems (ILS). This caveat resulted in the use of two simplifying assumptions, as follows.

Assumption 4: The total cost of acquiring C4ISR assets and modernizing ILS is unaffected by acceleration acquisition. This assumption is reasonable for the purposes of estimating acquisition costs, since C4ISR and ILS acquisition costs account for only 7 percent of the total acquisition costs for Deepwater, as shown in Figure 3.1.

Assumption 5: Annual operating and support cost streams for C4ISR and ILS assets are unaffected by acceleration. This is a reasonable assumption for C4ISR asset operating and support costs because, at most, they represent 2.5 percent of the total under the 20-year acquisition schedule. While ILS asset operating and support costs typically represent 37 percent of the total under this 20-year acquisition, the ILS costs vary by only a couple of percentage points from year to year.

Figure 3.1
Percentage of Total Deepwater Acquisition Cost, by Asset Type



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Objectives and Constraints

The RAND research team considered two objectives in the design of accelerated-acquisition schedules. One objective was to schedule the acquisition of assets in a manner that minimizes total acquisition cost. For example, it might be possible to acquire a replacement asset at an earlier date than originally planned, thereby avoiding a costly SLE associated with the legacy asset it replaces. Another objective was to accelerate the acquisition of assets with low annual maintenance costs relative to the legacy assets they replace. RAND researchers attempted to optimize these two objectives subject to constraints on production rates, on lead time for the procurement of long-lead items, and on lead time for asset design.

The RAND team kept in mind that the acquisition of some asset classes must be coordinated. For instance, the National Security Cutter and Offshore Patrol Cutter each accommodate Long Range

Interceptors. It was important in our analysis to keep at least one Long Range Interceptor in service for each National Security Cutter and Offshore Patrol Cutter in service. RAND imposed this constraint on the design of accelerated-acquisition schedules. Similarly, the National Security Cutter, Offshore Patrol Cutter, and PB-123 each accommodate Short Range Prosecutors. Therefore, RAND constrained the number of Short Range Prosecutors in service per year to be at least equal to the total number of National Security Cutters, Offshore Patrol Cutters, and PB-123s in service.

RAND also recognized that there are constraints between surface and air assets. The National Security Cutter and Offshore Patrol Cutter are designed to support air vehicles, and each has space for one of the following sets of assets:

- two helicopters
- one helicopter and two VUAVs
- four VUAVs.

We coordinated the acquisition schedule for these assets with those of the National Security Cutter and Offshore Patrol Cutter assets.

The RAND team assumed that the remaining service life of legacy assets could not be extended beyond the service life implied by the Deepwater acquisition schedule. That is, if the Deepwater acquisition schedule called for an asset to be decommissioned by a specific date, then that asset would be decommissioned no later than that date in any accelerated-acquisition schedule.

RAND's Comparison of Three Acquisition Schedules

RAND estimated annual acquisition and operating and support costs from 2002 until the year in which acquisition is complete. The baseline Deepwater plan calls for acquisition to be complete in 2022; hence, the baseline plan estimates costs over a 20-year period. RAND decided to investigate two acceleration plans. First, RAND investigated a 15-year plan, in which acquisition is complete in the year

2017. Second, RAND investigated a 10-year plan, in which acquisition is complete in the year 2012. It was deemed unlikely that acquisition could be accelerated much more than 10 years, in view of design and production lead-time constraints arising from industrial-base considerations, which are discussed in more detail later in this chapter. This limit drove the decision to investigate a 10-year acquisition schedule. We decided to investigate the 15-year acquisition schedule, since it is a midpoint between the 10-year and the original 20-year Deepwater acquisition schedule.

Can Acquisition of Deepwater Assets Be Accelerated?

Before attempting to design 15-year and 10-year accelerated-acquisition schedules, it was necessary to take a broad look at the feasibility of accelerating acquisition at all. We began by looking at the acquisition schedules for groups of assets.

There are two ways to accelerate the acquisition of an asset or group of assets: start procurement at an earlier date than originally planned and/or produce the asset or asset group at a higher rate than originally planned. RAND relied on the information gathered from the manufacturers through surveys and from interviews to determine whether acquisition for each asset or asset group could be accelerated using either approach.

RAND found that it is possible to accelerate the acquisition of all assets; the results are listed in Table 3.1. From the table, we see that for most assets, it is possible to start procurement earlier and to produce them at a higher rate. Procurement could not be started earlier for the National Security Cutter and Maritime Patrol Aircraft, since it has already begun. The production rate of the National Security Cutter is already high; however, in consultation with the manufacturer, it was determined that the annual production rate could be increased slightly, as displayed in the tables that follow. The Fast Response Cutter production rate is already extremely high in the Deepwater schedule, and it cannot be increased further. However, procurement of the Fast Response Cutter could begin much earlier.

Table 3.1
Manufacturer Ability to Accommodate Accelerated Acquisition, by Asset Class

Assets	Force Structure	
	Start Procurement Earlier?	Produce at Higher Rate?
National Security Cutter (NSC)	No	Yes
Offshore Patrol Cutter (OPC)	Yes	Yes
Fast Response Cutter (FRC)	Yes	No
Maritime Patrol Aircraft (MPA)	No	Yes
Medium Range Recovery Helicopter (VRS)	Yes	Yes
Short Range Recovery Helicopter (MCH)	Yes	Yes
VSTOL UAV	Yes	Yes
HAEUAV	Yes	Yes

Accelerating the Deepwater Acquisition Schedule from 20 Years to 15 Years

After identifying the lead-time and production-rate constraints and determining that all assets could be accelerated, RAND developed the 15-year and the 10-year accelerated-acquisition schedules. The design of the accelerated-acquisition schedules was driven by a study of the cost, performance, and industrial-base impacts, which are discussed later in this chapter. However, we mention here some of the key drivers of the design before presenting the acquisition schedules.

We looked for opportunities to avoid costly SLEs, particularly with the Medium Endurance Cutters, by accelerating the acquisition of the Offshore Patrol Cutters that replace them. However, according to official ICGS estimates, the most costly SLE programs were already well under way when the study began. As a result, few opportunities for savings were presented through avoidance of SLEs for the Medium Endurance Cutters.

The same vendor supplies the National Security Cutters and Offshore Patrol Cutters; therefore, we had to consider the effects on labor of overlapping schedules for these assets. The National Security Cutters are expected to have lower operating and support costs than the High Endurance Cutters they replace. Consequently, for the National Security Cutters, we accelerated the acquisition schedules as much as possible for both the 15-year and 10-year plans, staying within the production rate and lead-time constraints determined in conjunction with the vendor. In fact, the acquisition schedule for the National Security Cutters is identical for the 15-year and 10-year plan. The production rate for the Offshore Patrol Cutter is more relaxed in the 15-year plan than in the 10-year plan, and we used information provided by the vendor to model turbulence in the labor force and estimate the impacts on acquisition costs, which are discussed later in this chapter.

We found the greatest opportunity for acquisition-cost savings to be associated with surface assets, in reducing the number of PB-110–to–PB-123 conversions. The original 20-year Deepwater acquisition schedule has all 49 of the PB-110 110-foot patrol boats being converted to PB-123 123-foot patrol boats. Eventually, all 49[6] of the converted PB-123s are decommissioned and replaced with Fast Response Cutters. We found that, by accelerating the acquisition of the Fast Response Cutters, we could reduce the number of conversions that are required and realize some acquisition-cost savings.

Table 3.2 lists the number of surface assets in service per year under the 15-year acquisition schedule. The same information is shown graphically in Figure 3.2. (The timeline for the baseline is also indicated in Figure 3.2.) Acquisition is complete in 2017 under this plan. The production rate of the National Security Cutters was increased so that procurement of this asset is complete in 2011 instead of in 2013. Acquisition of the Offshore Patrol Cutters is complete in 2017 and is accomplished through a combination of starting procurement earlier and increasing production rate. Acquisition of

[6] The original Deepwater force consisted of 49 PB-110s as of 1998. As of 2003, two have already been taken out of service. Hence, our tables indicate 47 PB-110s as of 2003.

Table 3.2
Number of Surface Assets in Service at End of Calendar Year, Deepwater 15-Year Acquisition Schedule

Year	WHEC	NSC	WMEC	OPC	PB-110	PB-123	FRC	LRI[a]	SRP[a]
2002	12	0	32	0	47	0	0	0	0
2003	12	0	32	0	40	4	0	0	4
2004	12	0	32	0	33	11	0	0	10
2005	12	0	32	0	26	18	0	0	18
2006	11	1	31	0	19	25	0	1	26
2007	10	2	30	1	12	31	1	4	34
2008	9	3	28	3	5	34	5	9	40
2009	6	5	26	5	0	34	11	14	44
2010	3	7	24	7	0	34	17	19	48
2011	1	8	21	10	0	29	23	24	54
2012	0	8	18	13	0	24	29	29	58
2013	0	8	15	16	0	19	35	34	64
2014	0	8	12	19	0	14	41	39	70
2015	0	8	9	22	0	9	47	42	76
2016	0	8	4	25	0	4	53	42	82
2017	0	8	0	25	0	0	58	42	82

[a]LRIs and SRPs are not included in Figure 3.2.

the Fast Response Cutter was accelerated by starting procurement at an earlier date; delivery of Fast Response Cutters begins in 2007, which, according to the manufacturer, provides ample lead time for design of the asset. Note that the RAND team actually decreased the production rate of the Fast Response Cutter under the 15-year plan, which should result in a schedule with lower risk of production delays. The number of PB-110–to–PB-123 interim conversions is reduced from the 49 planned in the Deepwater schedule to only 34 in the 15-year plan.

Figure 3.2
Number of Surface Assets in Service at End of Calendar Year, Deepwater 15-Year Acquisition Schedule

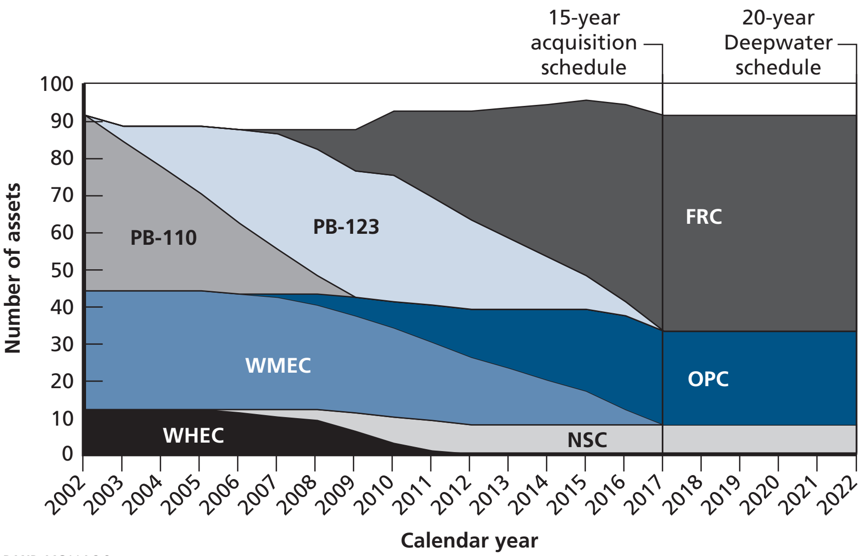

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Table 3.3 lists the number of air assets in service per year under the 15-year acquisition schedule. The same information is shown graphically in Figure 3.3. Acquisition of the Medium Range Recovery Helicopter (VRS) was accelerated by starting procurement at an earlier date. Acquisition of the VUAV was accelerated by starting procurement at an earlier date and by increasing the production rate. It was not necessary to accelerate the acquisition schedules for the Maritime Patrol Aircraft, Short Range Recovery Helicopter (MCH), and HAEUAV in the 15-year plan.

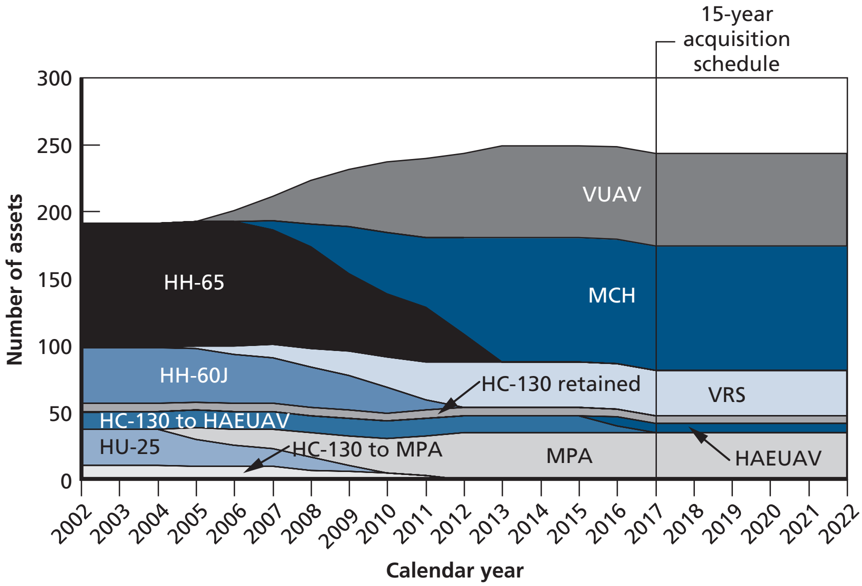
Table 3.3
Number of Air Assets in Service at End of Calendar Year, Deepwater 15-Year Acquisition Schedule

Year	HC-130	HH-60J	HH-65	HU-25	VRS	VUAV	MPA	MCH	HAEUAV
2002	30	42	93	27	0	0	0	0	0
2003	30	42	93	27	0	0	0	0	0
2004	30	42	93	27	0	0	0	0	0
2005	29	40	93	20	2	0	9	0	0
2006	29	37	93	16	6	8	12	0	0
2007	29	34	86	13	10	18	15	7	0
2008	26	30	76	10	14	33	18	17	0
2009	25	26	58	5	18	43	22	35	0
2010	24	19	47	0	23	53	26	46	0
2011	22	8	41	0	28	59	30	52	0
2012	19	0	21	0	34	63	35	72	0
2013	19	0	0	0	34	69	35	93	0
2014	19	0	0	0	34	69	35	93	0
2015	19	0	0	0	34	69	35	93	0
2016	11	0	0	0	34	69	35	93	7
2017	6	0	0	0	34	69	35	93	7

Accelerating the Deepwater Acquisition Schedule from 20 Years to 10 Years

Table 3.4 lists the number of surface assets in service per year under the 10-year acquisition schedule. The same information is shown graphically in Figure 3.4. Acquisition is complete in 2012 under this plan. The acquisition schedule for the National Security Cutter is identical under the 15-year plan and the 10-year plan. Acquisition of the Offshore Patrol Cutters is complete in 2012 as a result of a combination of starting procurement earlier and increasing production rate, with respect to the 20-year acquisition plan. Acquisition of the Fast Response Cutter was accelerated by starting procurement at an earlier date; delivery of Fast Response Cutters begins in 2006. According to the manufacturer, this schedule provides sufficient

Figure 3.3
Number of Air Assets in Service at End of Calendar Year, Deepwater 15-Year Acquisition Schedule



RAND *MG114-3.3*

lead time for design of the asset. However, it is the view of the RAND team that there is not much tolerance in this schedule to account for the possibility of delay in the design process. The number of PB-110–to–PB-123 interim conversions is reduced from the 49 planned in the Deepwater schedule to only 24 in the 10-year plan.

Table 3.5 lists the number of air assets in service per year under the 10-year acquisition schedule. The same information is shown graphically in Figure 3.5. The acquisition schedule for the Medium Range Recovery Helicopter (VRS) is identical to that used in the 15-year plan. Acquisition of the VUAV was accelerated by starting procurement at an earlier date and by increasing the production rate. Acquisition of the HAEUAV was accelerated by starting procurement at an earlier date. Acquisition of the Short Range Recovery

Table 3.4
Number of Surface Assets in Service at the End of Calendar Year, Deepwater 10-Year Acquisition Schedule

Year	WHEC	NSC	WMEC	OPC	PB-110	PB-123	FRC	LRI[a]	SRP[a]
2002	12	0	32	0	47	0	0	0	0
2003	12	0	32	0	40	4	0	0	4
2004	12	0	32	0	33	11	0	0	11
2005	12	0	32	0	26	18	0	0	20
2006	11	1	32	0	19	24	1	1	29
2007	10	2	31	1	12	24	8	6	38
2008	9	3	28	4	5	24	15	14	47
2009	6	5	24	8	0	24	25	22	56
2010	3	7	19	13	0	16	35	30	65
2011	1	8	12	18	0	8	46	36	74
2012	0	8	0	25	0	0	58	42	82

[a]LRIs and SRPs are not included in Figure 3.4.

Figure 3.4
Number of Surface Assets in Service at End of Calendar Year, Deepwater 10-Year Acquisition Schedule

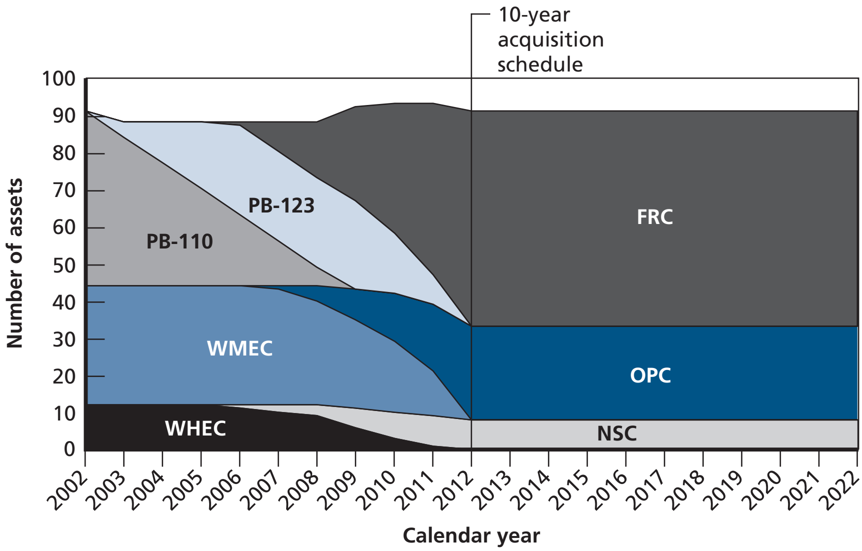


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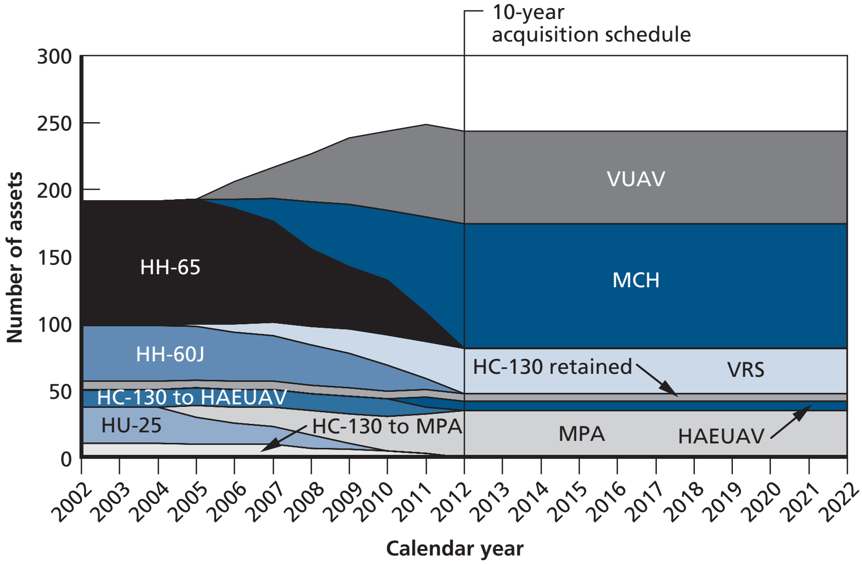
Table 3.5
Number of Air Assets in Service at End of Calendar Year, Deepwater 10-Year Acquisition Schedule

Year	HC-130	HH-60J	HH-65	HU-25	VRS	VUAV	MPA	MCH	HAEUAV
2002	30	42	93	27	0	0	0	0	0
2003	30	42	93	27	0	0	0	0	0
2004	30	42	93	27	0	0	0	0	0
2005	29	40	93	20	2	0	9	0	0
2006	29	37	86	16	6	8	12	7	0
2007	29	34	76	13	10	18	15	17	0
2008	26	30	58	10	14	36	18	35	0
2009	25	26	47	5	18	51	22	46	0
2010	24	19	41	0	23	62	26	52	0
2011	14	8	21	0	28	69	30	72	7
2012	6	0	0	0	34	69	35	93	7

Figure 3.5
Number of Air Assets in Service at End of Calendar Year, Deepwater 10-Year Acquisition Schedule



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Helicopter (MCH) was accelerated by starting procurement at an earlier date. It was not necessary to accelerate the acquisition schedules for the Maritime Patrol Aircraft.

What Are the Performance Implications of Acceleration?

We found that acquiring Deepwater assets over 15- or 10-year schedules would allow the USCG to operate surface and air assets for significantly more mission hours and to increase the detection coverage area for airborne sensors than with capabilities it would acquire using a 20-year acquisition schedule. The USCG would begin to benefit from the additional mission hours and detection coverage area as early as 2006 under both the 15- and 10-year acquisition schedules.

We could have chosen many other ways to measure performance capabilities; however, we chose increased mission hours and detection coverage area because they provide important information to the decisionmaker and could be calculated, with a minimal number of assumptions, based on information available now. These measures of performance provide an excellent starting point from which a detailed estimate of effectiveness implications could be made as additional technical information becomes available.

Implications of Acceleration on Annual Mission Hours

For surface assets, we calculated annual mission hours by multiplying the number of days each asset is under way for mission use—called *annual underway days*—by 24, the number of hours in a day. For air assets, we used each asset's programmed flight hours as a direct proxy for its annual mission hours.

Using CNA calculations of annual underway days and programmed flight hours for air assets (Nordstrom and Partos, 2002, p. 28), RAND derived mission hours for legacy and replacement surface and air assets, which are summarized in Tables 3.6 and 3.7,

Table 3.6
Annual Mission Hours per Legacy Asset

Asset Class	Annual Mission Hours
WHEC	3,984
WMEC (Average)	4,025
PB-110	1,740
HC-130	800
HU-25	800
HH-60	725
HH-65	645

Table 3.7
Annual Mission Hours per Deepwater Asset[a]

Asset Class	Annual Mission Hours
National Security Cutter	5,592
Offshore Patrol Cutter	5,286
PB-123	1,740
Fast Response Cutter	2,940
LRS	934
MPA	1,200
HAEUAV	2,300
VRS	800
MCH	700
VUAV	1,200

[a]Clearly, we cannot equate the mission-hour performance of, say, a small cutter with the mission-hour performance of a large cutter, because each may have differing responsibilities. Rather, we look at the aggregate performance of the Deepwater fleet and see how it varies over time, depending on the acquisition plan.

respectively. Note that the annual mission hours listed in these tables are for a single asset of the specified asset class.[7]

[7] USCG policy limits personnel to 185 days per year away from home port (DAFHP). The IDS crew augmentation plan allows NSC and OPC to operate more than 185 underway days per year.

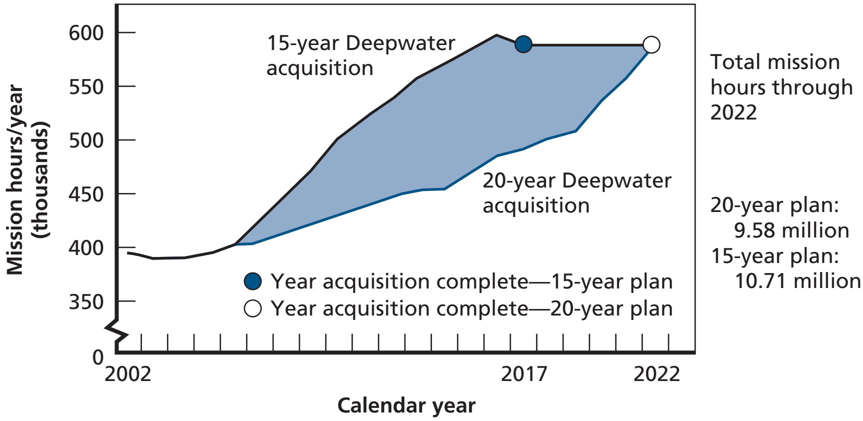
Figure 3.6 shows the annual number of mission hours for the entire Deepwater fleet under the 20-year and 15-year acquisition plans. Observe that the legacy fleet provides approximately 400,000 mission hours per year and that the completed replacement fleet provides approximately 600,000 mission hours per year. The lower curve represents the annual number of mission hours under the 20-year plan, and the upper curve represents the annual number of mission hours under the 15-year plan. The shaded area between the two lines represents the total number of additional mission hours that are made available to the USCG through the process of accelerating acquisition. By accelerating acquisition using the 15-year plan, the total number of mission hours available to the USCG over a 20-year period increases from 9.6 million to 10.7 million, an increase of 12 percent. The USCG would begin to benefit from the increase in mission hours as early as 2006.

Figure 3.7 shows the annual number of mission hours for the entire Deepwater fleet under the 20-year and 10-year acquisition schedules. Again, the shaded area between the two lines represents the total number of additional mission hours that are made available to the USCG through the process of accelerating acquisition. For this case, accelerating acquisition with the 10-year schedule increases the total number of mission hours available to the USCG over a 20-year period from 9.6 million to 11 million, or 15 percent. The USCG would begin to benefit from the increase in mission hours as early as 2006.

Implications of Acceleration on Annual Airborne Sensor-Detection-Area Coverage

The detection coverage area of airborne sensors can be evaluated as a function of the range of the airborne sensor, the patrol speed of the

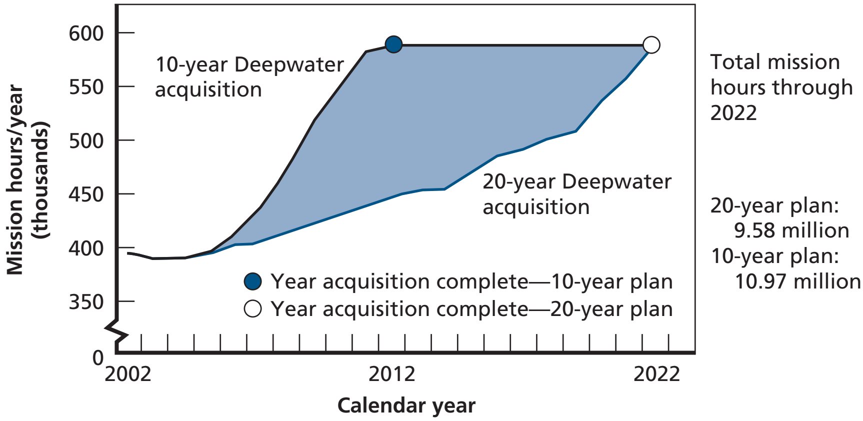
Figure 3.6
Annual Number of Mission Hours for Deepwater Fleet Under 20-Year and 15-Year Acquisition Schedules



Additional mission hours from acceleration.

RAND *MG114-3.6*

Figure 3.7
Annual Number of Mission Hours for Deepwater Fleet Under 20-Year and 10-Year Acquisition Schedules



Additional mission hours from acceleration.

RAND *MG114-3.7*

sensor platform, and the annual number of hours the airborne sensor is on patrol.[8]

Tables 3.8 and 3.9 display the annual detection coverage areas for legacy and replacement airborne sensors. Note that the annual detection coverage areas listed in the tables are for a single asset of the specified asset class.

Table 3.8
Annual Detection Coverage Area for Airborne Sensors Aboard Legacy Assets

Asset Class	Annual Detection Coverage Area (million square nautical miles per year)
HC-130	17.86
HU-25	14.28
HH-60	0.87
HH-65	0.71

Table 3.9
Annual Detection Coverage Area for Airborne Sensors Aboard Replacement Assets

Asset Class	Annual Detection Coverage Area (million square nautical miles per year)
LRS	38.81
MPA	36.91
HAEUAV	51.17
VRS	1.91
MCH	1.56
VUAV	8.74

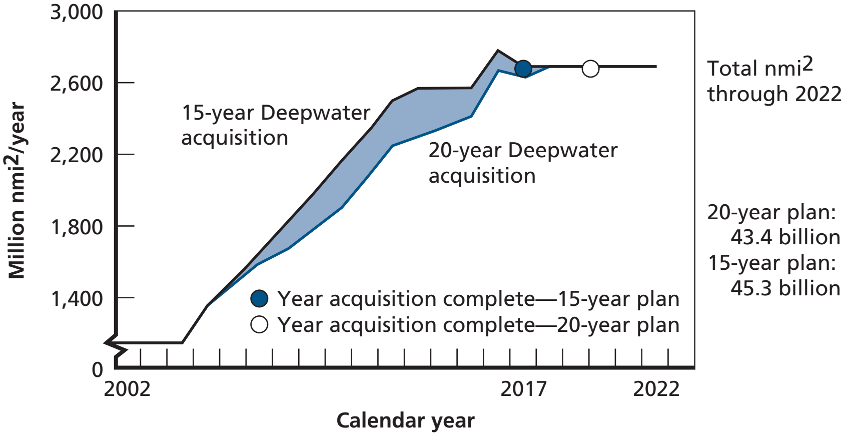
[8] In mathematical terms, this detection coverage area can be expressed according to the following formulation (Nordstrom and Partos, 2002): Let r denote the range of the airborne sensor in nautical miles, p denote the patrol speed in knots, and h denote the annual number of hours the airborne sensor is on patrol. Let a denote the detection coverage area of the airborne sensor in square nautical miles per year. We can evaluate a from the formula $a = 2rph$.

Figure 3.8 shows the annual detection coverage area for the entire Deepwater fleet of airborne sensors under the 20-year and 15-year acquisition schedules. Figure 3.9 shows the same data for the 20-year and 10-year scenarios. Observe that the legacy fleet provides approximately 1.1 billion nmi^2 of detection coverage area per year; when complete, the replacement fleet will cover approximately 2.7 billion nmi^2 of detection coverage area per year. In both figures, the bottom curve represents the annual detection coverage area under the 20-year schedule; in Figure 3.8, the top curve represents the annual detection coverage area under the 15-year schedule, whereas, in Figure 3.9, the top curve represents that same area obtained by the 10-year scenario. In both figures, the shaded area represents the total number of additional square nautical miles of detection coverage that are made available to the USCG, over a 20-year period, through the process of accelerating acquisition. With the 15-year schedule, the total detection coverage area over a 20-year period increases from 4,340 million nmi^2 to 4,530 million nmi^2, an increase of 4 percent. With the 10-year schedule, the detection coverage area climbs to 4,640 million nmi^2, an increase of 7 percent. The USCG would begin to benefit from the increase in detection coverage area as early as 2006 under both the 10- and 15-year acquisition schedules.

The performance implications of acceleration can be summarized as follows:

- By accelerating acquisition from 20 years to 15 years, the total number of mission hours will increase by 12 percent and the detection coverage area of airborne sensors will increase by 4 percent over a 20-year period.
- By accelerating acquisition from 20 years to 10 years, the total number of mission hours will increase by 15 percent and the detection coverage area of airborne sensors will increase by 7 percent over a 20-year period.
- The USCG would begin to benefit from the increase in annual mission hours and detection coverage area of airborne sensors as early as 2006 under both the 10- and 15-year acquisition schedules.

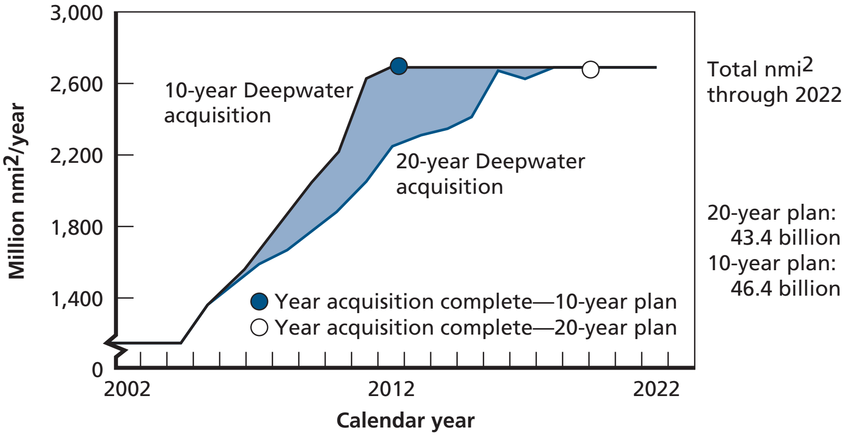
Figure 3.8
Annual Detection Coverage Area of Deepwater Fleet Airborne Sensors Under 20-Year and 15-Year Acquisition Schedules



Additional square nautical miles from acceleration.

RAND *MG114-3.8*

Figure 3.9
Annual Detection Coverage Area of Deepwater Fleet Airborne Sensors Under 20-Year and 10-Year Acquisition Schedules



Additional square nautical miles from acceleration.

RAND *MG114-3.9*

What Are the Cost Implications of Acceleration?

We found that total acquisition costs for Deepwater would not significantly change if the acquisition program were accelerated. However, the more compressed the schedule is, the higher are the annual outlays. We also found that acceleration would not change the USCG's total operating and support costs. But, because acceleration would allow the USCG to operate for more mission hours, the USCG's operating and support costs per mission hour would decline under 15-year and 10-year schedules.

Implications for Acquisition Costs

We examined the implications of acceleration on acquisition costs by

- holding discussions with major manufacturers of surface and air assets
- employing analytic models to study the impact of acceleration on shipyard labor requirements and, in turn, to determine the impact of changes in labor costs for surface assets
- identifying and evaluating opportunities for avoiding expensive SLEs and interim conversions through acceleration.

The total acquisition costs (in FY1998 dollars) for the 20-year schedule, the 15-year schedule, and the 10-year schedule are listed in Table 3.10. The table shows that the total cost decreases by an estimated $200 million—or 2 percent—under the 15-year and 10-year schedules. This decrease is below the level of accuracy of RAND's models, which is estimated to be about 10 percent. Therefore, our interpretation is that the effect on total acquisition cost is negligible. Note that, for some assets, the acquisition cost increases. For example, a shipyard labor model indicated that the total cost of acquiring all National Security Cutters and Offshore Patrol Cutters increases by around $30 million for the 15-year plan and by $50 million for the 10-year plan, in FY1998 dollars. However, there is a decrease in the number of PB-110–to–PB-123 interim conversions that are

Table 3.10
Total Acquisition Costs for 20-Year, 15-Year, and 10-Year Acquisition Schedules (Including Cost of Surface, Air, and C4ISR Assets Plus ILS Modernization)

Schedule	Total Acquisition Cost (FY1998$)
20-Year	$8.2 billion
15-Year	$8.0 billion
10-Year	$8.0 billion

necessary: 49 conversions in the 20-year acquisition schedule, 34 in the 15-year schedule, and 24 in the 10-year schedule. The average cost is $4.9 million each in FY1998 dollars, according to ICGS cost estimates.[9]

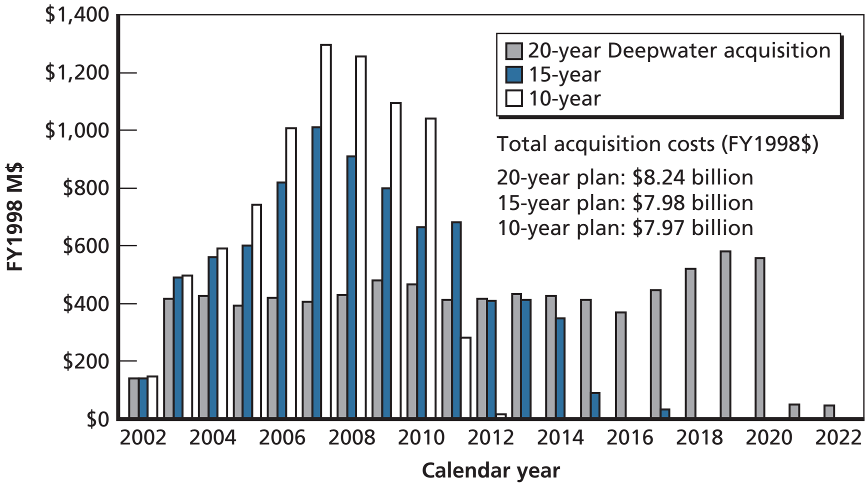
Since the total acquisition cost changes nearly negligibly as a result of acceleration, the annual outlays in the acquisition-cost streams (in FY1998 dollars) for the accelerated acquisition plans will increase, as shown in Figure 3.10. For example, if the USCG reduces Deepwater's acquisition timeline from 20 years to 15 years, its maximum annual outlay rises from $600 million to $1 billion. For the 10-year timeline, that maximum would climb to around $1.3 billion. Average annual outlays, which amount to $400 million in the 20-year schedule, would rise to $500 million with the 15-year scenario. They would hit $700 million under a 10-year timetable.

Implications for Operating and Support Costs

Determining the implications of acceleration for operating and support costs was straightforward, given the cost estimates from the D159 tables (ICGS, 2002) and the acquisition schedules. The

[9] This estimate was eventually increased to $6.8 million in FY1998 dollars.

Figure 3.10
Acquisition Cost Streams for 20-Year, 15-Year, and 10-Year Acquisition Schedules (Including Cost of Surface, Air, and C4ISR Assets Plus ILS Modernization)

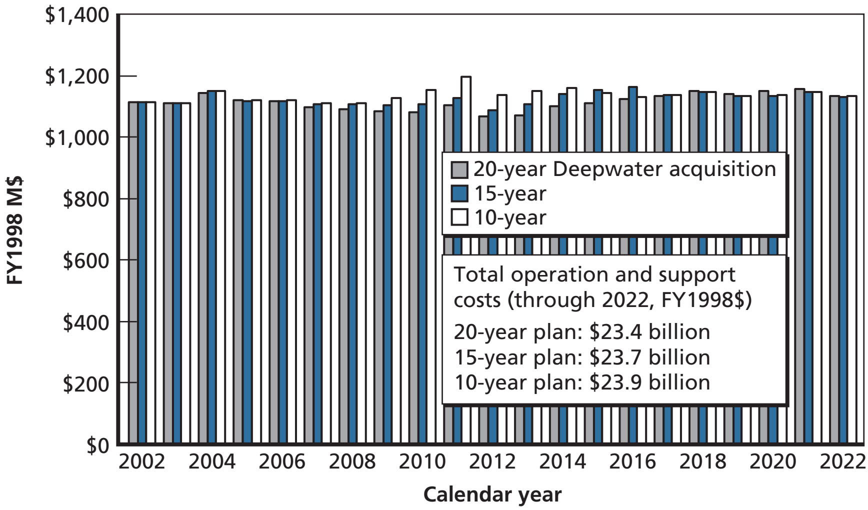


RAND ASSUMPTION: Total C4ISR and Integrated Logistics Support costs are the same regardless of acquisition schedule.
RAND *MG114-3.10*

operating and support cost streams are shown in Figure 3.11. Observe that there is almost no variation in annual operating and support costs under any of the acquisition plans. That is, the annual operating and support costs for the legacy assets and ILS are approximately the same as the annual operating and support costs for the replacement assets and modernized ILS.

Figure 3.12 shows the annual operating and support cost per mission hour for the 20-year, 15-year, and 10-year acquisition schedules. We derived this cost by dividing the annual operating and support cost by the corresponding annual number of mission hours. The figure displays the fall in average operating and support cost per mission hour over time for all Deepwater assets. That cost declines by about 25 percent from the current operating and support level under any of the acquisition schedules, to less than $1,400 per hour.

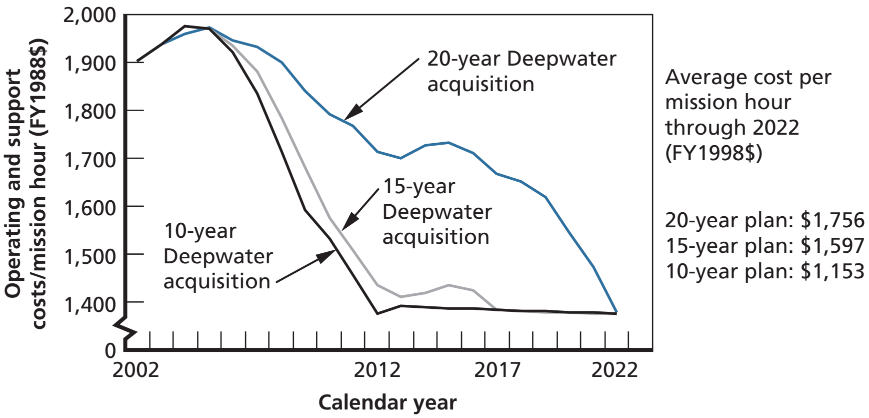
Figure 3.11
Operating and Support Cost Streams for 20-Year, 15-Year, and 10-Year Acquisition Schedules (Includes Cost of Surface, Air, and C4ISR Assets Plus ILS Modernization)



RAND ASSUMPTION: Annual C4ISR and Integrated Logistics Support costs are the same regardless of acquisition schedule.
RAND *MG114-3.11*

Table 3.11 shows operating and support cost data for the total, average annual, and average mission hour depicted graphically in Figures 3.11 and 3.12. It displays total and average costs (in FY1998 dollars) over the period 2002 through 2022, accrued under the 20-year, 15-year, and 10-year schedules. The table shows that the average operating and support cost of $1,756 per mission hour for the 20-year schedule drops to $1,597 in the 15-year schedule (a 9-percent reduction) and to $1,573 in the 10-year schedule (a 10-percent reduction).

Figure 3.12
Annual Operating and Support Cost per Mission Hour for 20-Year, 15-Year, and 10-Year Acquisition Schedules (Including Cost of Surface, Air, and C4ISR Assets Plus ILS Modernization)



NOTE: Mission hour = Aircraft programmed flight hours + Cutter underway days x 24.
RAND *MG114-3.12*

Table 3.11
Operating and Support Costs for the 20-Year, 15-Year, and 10-Year Acquisition Schedules, 2002–2022 (Including the Cost of Surface, Air, and C4ISR Assets Plus ILS Modernization)

Operating and Support Costs (FY1998$)	20-Year Schedule	15-Year Schedule	10-Year Schedule
Total	$23.4 billion	$23.7 billion	$23.9 billion
Average Annual	$ 1.1 billion	$ 1.1 billion	$ 1.1 billion
Average Annual/Mission Hour	$1,756	$1,597	$1,573

The cost implications of acceleration can be summarized as follows:

- RAND models predict that acceleration will have a negligible effect on annual and total operating and support costs.
- The average annual operating and support cost per mission hour over the period 2003 through 2022 is 9 percent lower under the 15-year plan and 10 percent lower under the 10-year acquisition schedule than that for the 20-year schedule.
- RAND models predict that acceleration will have a negligible effect on total acquisition costs (a 2-percent reduction is predicted, which is well below the accuracy of the RAND models).
- Although acceleration would have a negligible effect on total acquisition costs, it would increase annual outlays. Under the 15-year schedule, maximum annual outlays (in FY1998 dollars) increase to $1 billion from $600 million in the 20-year schedule. They would climb to $1.3 billion under the 10-year schedule.

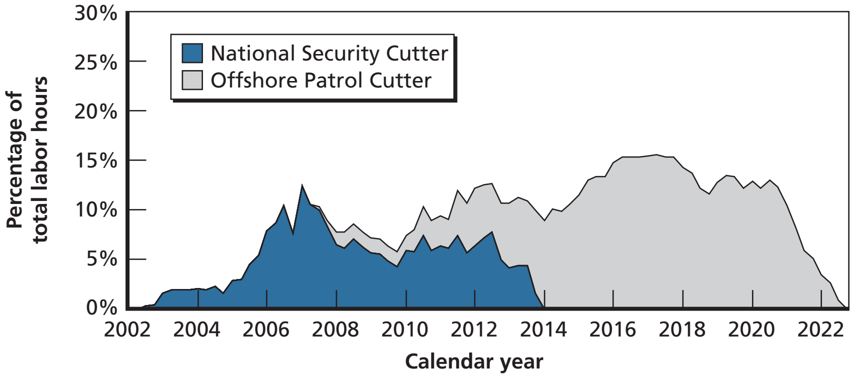
What Are the Industrial-Base Implications of Acceleration?

The U.S. shipbuilding industrial base can accommodate accelerating the USCG's Deepwater acquisitions either to a 15-year or a 10-year schedule. We came to this conclusion after reviewing information we obtained through our surveys of manufacturers, through interviews, and through quantitative results of RAND's analytic models.

Implications of Acceleration for Shipyard Industrial Base

The National Security Cutter and Offshore Patrol Cutter are being manufactured by Northrop Grumman Ship Systems. Figure 3.13 shows the percentage of total Northrop Grumman shipyard labor hours devoted to the National Security Cutter and Offshore Patrol Cutter under the 20-year acquisition schedule. We see from this

Figure 3.13
Percentage of Total Shipyard Labor Hours at Northrop Grumman Ship Systems Under the 20-Year Acquisition Schedule

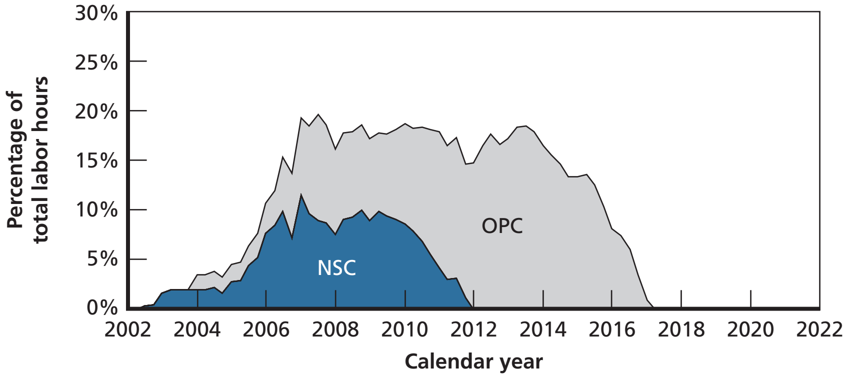


NOTE: Average used for estimating non–Deepwater work beyond 2014.
RAND *MG114-3.13*

figure that Deepwater work would demand, at most, 15 percent of the company's shipyard labor. Note that this figure corresponds to the combined labor requirements for the Avondale and Pascagoula shipyards of Northrop Grumman Ship Systems.

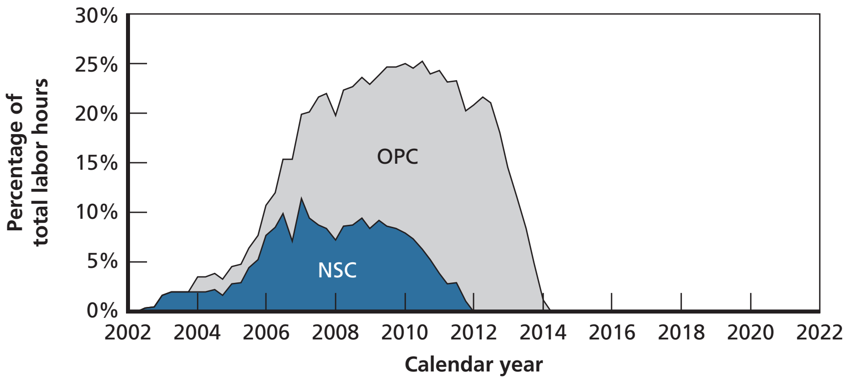
Figures 3.14 and 3.15 show the percentage of total shipyard labor hours at Northrop Grumman devoted to the National Security Cutter and Offshore Patrol Cutter under 15-year and 10-year acquisition scenarios. In a 15-year timetable, Deepwater work would demand at most 20 percent of the company's shipyard labor hours. The shipyard labor portion of RAND's Industrial Base Model predicted that the labor cost for producing all of the National Security Cutter and Offshore Patrol Cutter assets would increase by approximately $30 million (FY1998 dollars) under this 15-year schedule, owing to fluctuations in the labor demand. This increase is less than 1 percent of the total cost and is well below the accuracy of the model, suggesting that the effect of the increase on the shipyard labor requirements is negligible.

Figure 3.14
Percentage of Total Shipyard Labor Hours at Northrop Grumman Ship Systems Under the 15-Year Acquisition Schedule



NOTE: Average used for estimating non–Deepwater work beyond 2014.
RAND *MG114-3.14*

Figure 3.15
Percentage of Total Shipyard Labor Hours at Northrop Grumman Ship Systems Under the 10-Year Acquisition Schedule



NOTE: Average used for estimating non–Deepwater work beyond 2014.
RAND *MG114-3.15*

In the 10-year acquisition scenario, Deepwater work would demand, at most, 25 percent of Northrop Grumman's shipyard labor hours. According to the shipyard labor portion of RAND's Industrial Base Model, labor costs associated with producing all of the National Security and Offshore Patrol Cutters would climb by approximately $50 million (FY1998 dollars), again as a result of fluctuations in labor demand. This increase is less than 1 percent of the total cost and is well below the accuracy of the model.

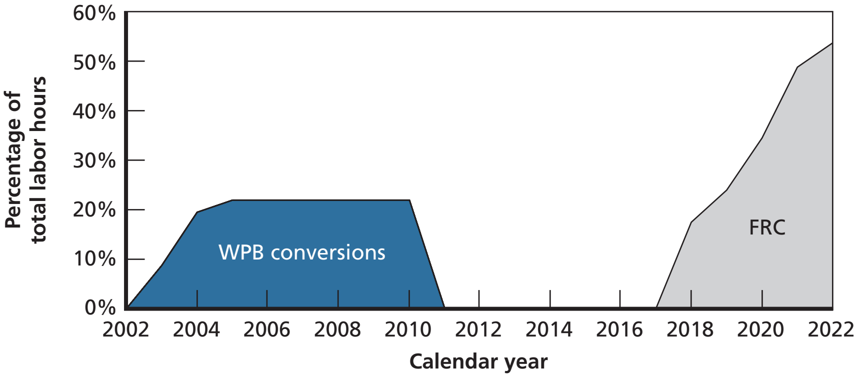
Through interviews and surveys, we determined that no major facility upgrades would be required for the 10-year or the 15-year acceleration plans. In general, the acceleration plans would have a negligible effect on the industrial base of Northrop Grumman Ship Systems.

Bollinger Shipyards is converting the PB-110s to PB-123s, which would involve 49 conversions under the 20-year acquisition plan, 34 under the 15-year plan, and 24 under the 10-year plan. Bollinger, in partnership with Halter Shipyards, also is supplying the Fast Response Cutters. Each shipbuilder will produce 29 Fast Response Cutters, bringing the total to 58. Bollinger will build the first-of-class, and Halter will build the second Fast Response Cutter. Bollinger and Halter will continue to alternate construction. Bollinger and Halter have arrangements to share information between shipyards in order to benefit the learning process.

Figure 3.16 shows the percentage of total shipyard labor hours at Bollinger Shipyards devoted to the PB-110–to–PB-123 conversions and to the construction of Fast Response Cutters under the 20-year Deepwater acquisition plan. Note that the RAND team used an average of the work over a two-year period in order to estimate all non-Deepwater work.[10] We see from the figure that the PB-110–to–PB-123 conversions represent about 20 percent of the total labor hours at Bollinger and that the rapid production of the Fast Response Cutters from 2018 to 2022 could account for as much as 54 percent of the total labor hours.

[10] We used a two-year average because we obtained only enough data to cover two years.

Figure 3.16
Percentage of Total Shipyard Labor Hours at Bollinger Shipyards Under the 20-Year Acquisition Schedule

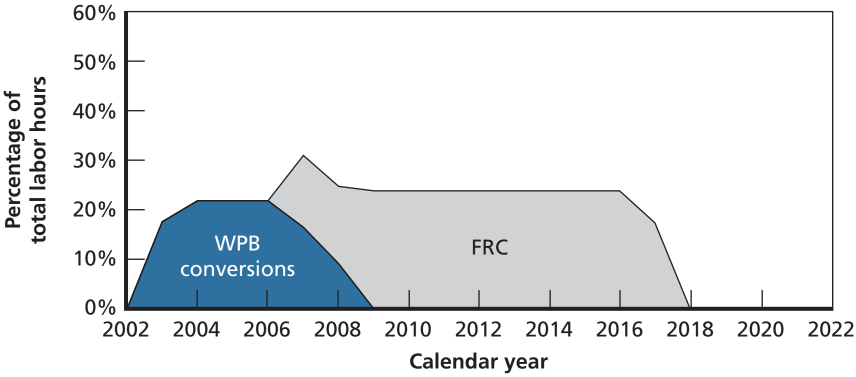


NOTE: 2-year average used for estimating all non–Deepwater work.
RAND *MG114-3.16*

Figures 3.17 and 3.18 show Bollinger's labor hours for the same cutters under 15-year and 10-year schedules, respectively. In the 15-year scenario, the number of PB-110–to–PB-123 conversions drops from 49 to 34, which represents a 2.3-percent loss of labor hours for all shipyard labor through 2022. However, this acquisition schedule calls for production of the Fast Response Cutter to overlap the conversion work, which in the short run will offset the loss of labor hours from doing fewer conversions. No major facility upgrades are anticipated to support this acquisition schedule.

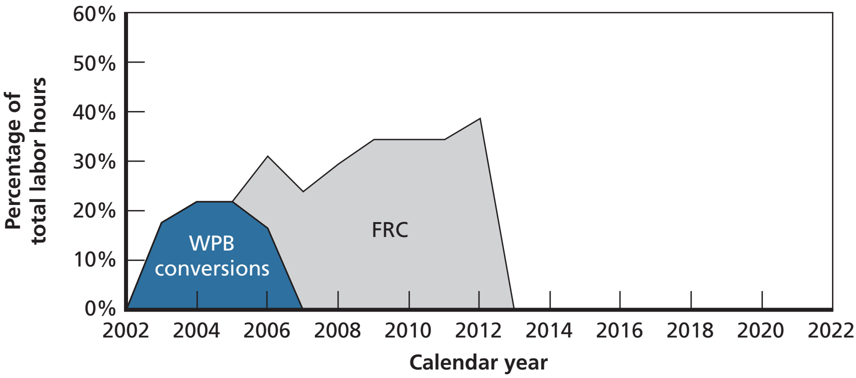
In the 10-year acquisition scenario, the number of PB-110–to–PB-123 conversions declines to 24, which represents a 3.8-percent loss of labor hours for all shipyard labor through 2022 compared with the 20-year acquisition timetable. However, the10-year acquisition schedule calls for production of the Fast Response Cutter to overlap the conversion work, which in the short run should

Figure 3.17
Percentage of Total Shipyard Labor Hours at Bollinger Shipyards Under the 15-Year Acquisition Schedule



NOTE: 2-year average used for estimating all non–Deepwater work.
RAND *MG114-3.17*

Figure 3.18
Percentage of Total Shipyard Labor Hours at Bollinger Shipyards Under the 10-Year Acquisition Schedule



NOTE: 2-year average used for estimating all non–Deepwater work.
RAND *MG114-3.18*

offset the loss of work. As with the 15-year scenario, no major facility upgrades are anticipated, which leads us to conclude that accelerating acquisition to either a 15- or a 10-year schedule will have a negligible effect on the industrial base at Bollinger.

Note that Halter is involved only in the production of the Fast Response Cutter. RAND researchers were not able to obtain detailed information on the current and projected workloads at the Halter shipyard. However, it appears that Halter, which currently has a slim order book, would be able to accommodate the earlier production start dates that would be required by accelerated acquisition timetables.

Implications of Acceleration on the Air Vehicle Industrial Base

The RAND team discussed the implications of accelerating acquisition with the major manufacturers of air assets: Eurocopter for the MCH, CASA for the MPA, Agusta/Bell for the VRS, and Bell Helicopter for the VUAV. The RAND team worked with each manufacturer to identify the maximum annual deliverable capacity possible and to determine the start year in which the maximum deliverable capacity is applicable.

Many of these data are proprietary and thus cannot be displayed in this report. However, we shared the data sets and our detailed analysis of them with the USCG. In general, by sharing with us data on current production rate and annual capacity, the air-vehicle manufacturers convinced us that they could satisfy the most demanding expected production runs that a 10-year acquisition schedule would require. As a result, we conclude that the air asset industrial base can accommodate either of the accelerated schedules.

The industrial-base implications of acceleration can be summarized as follows:

- No major facility upgrades to accommodate acceleration would be required for any of the manufacturers.
- Acceleration has a negligible effect on the industrial base of Northrop Grumman Ship Systems and the manufacturers of air assets.
- Compared with the labor hours it would require to work on the 20-year timetable, Bollinger Shipyard's labor hours would shrink by 2 percent with the 15-year schedule and by 4 percent with the 10-year schedule. These reductions would occur be-

cause of the lower number of PB-110–to–PB-123 conversions in the speedier timetables. However, these losses would be offset in the short run, inasmuch as work on the Fast Response Cutter would follow (and partially overlap) the conversions. As a result, there is a negligible effect on the industrial base of Bollinger Shipyards.

- Halter Shipyards appears to be able to accommodate an earlier production start date, as required under the 15-year and 10-year schedules.

Summary of the Implications of Accelerating the Deepwater Acquisition Schedule

Deepwater's replacement assets should offer enhanced mission performance over the legacy assets they replace. For instance, the fleet of replacement assets are designed to operate for more mission hours per year than the existing fleet of legacy assets is, and the airborne sensor coverage area is greater. Therefore, acceleration of acquisition should allow the USCG to benefit from enhanced mission performance beginning at an earlier date. For instance, the total number of mission hours over a 20-year period would increase by 12 percent with the 15-year schedule and by 15 percent with the 10-year schedule. The total airborne-sensor-detection coverage area over a 20-year period would increase by 4 percent with the 15-year schedule and by 7 percent with the 10-year schedule. The USCG would begin to benefit from the increases in performance of mission hours and airborne-sensor-detection coverage area as early as 2006 under both the 10- and 15-year acquisition schedules.

At the same time, acceleration would have a negligible effect on total operating and support costs over a 20-year period, annual operating and support costs, and total acquisition costs. Since there is a negligible effect on total acquisition costs, the annual outlays for acquisition will increase. The average annual outlays (in FY1998 dollars) will increase from $400 million to $500 million under the 15-year plan and to $700 million under the 10-year plan. The peak annual outlay will increase from $600 million to $1 billion under the 15-year plan and to $1.3 billion under the 10-year plan.

While Bollinger Shipyards will lose some PB-110–to–PB-123 conversion business with the accelerated acquisition plans, the losses will be offset in the short run by starting work on the Fast Response Cutter at an earlier date. Acceleration has a negligible effect on the industrial base of surface and air assets.

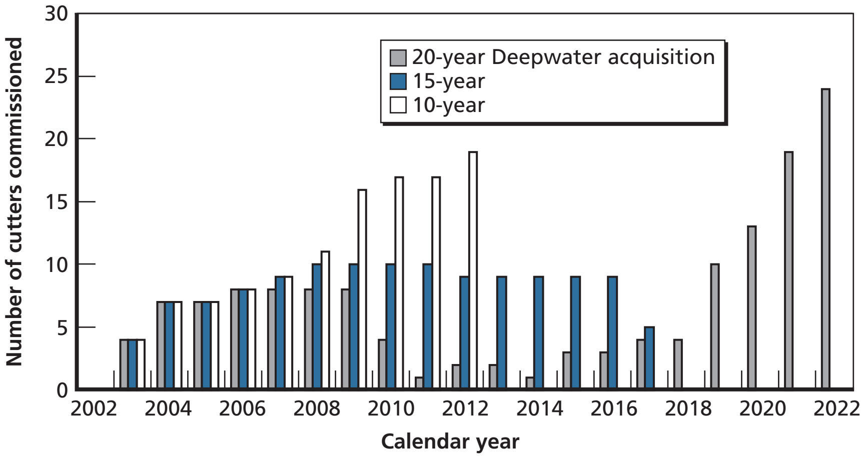
Postscript Question: Can the USCG Integrate Assets Faster Than Planned?

The rapid introduction of new assets may have implications for the USCG beyond the scope of the RAND study. For example, the rapid introduction of assets may mean that facilities will need to be upgraded to support the new assets. Additionally, personnel will have to be transitioned from legacy assets to new assets as the new assets are commissioned. This transitioning could have implications for training, retention, and recruitment of personnel.

Figure 3.19 shows the number of cutters commissioned in each year for the period 2002 through 2022 under the original 20-year and under the accelerated 15- and 10-year acquisition schedules. Observe that there is a rapid rate of commissioning of assets in the latter years of the original 20-year acquisition schedule, which is due to the high rate of introduction of Fast Response Cutters. It should be noted that the commissioning of a Fast Response Cutter will have a lesser effect on personnel than will the introduction of an Offshore Patrol Cutter or National Security Cutter: The manning requirements are smaller and the overall size of the ship is smaller. We see a similar rapid rate of commissioning of assets in the latter years of the 10-year accelerated acquisition schedule. The 15-year acquisition schedule results in a more even distribution of the number of commissionings per year, but in some years there are nearly 10 commissionings.

We recommend that the implications of accelerated-acquisition schedules on the USCG's ability to integrate new assets be investigated before implementation of an accelerated-acquisition schedule.

Figure 3.19
Cutters Commissioned per Year, 2002–2022, for the 20-Year, 15-Year, and 10-Year Acquisition Schedules



RAND *MG114-3.19*

CHAPTER FOUR

Will the Deepwater Plan Provide USCG with a Force Structure to Meet the Demands of Traditional Missions and Emerging Responsibilities?

In addition to exploring the feasibility of accelerating the Deepwater acquisition schedule, RAND was asked to determine whether the original Deepwater plan would provide the USCG with a force structure to meet mission demands.[1] This chapter describes the RAND team's evaluation of the force structure that the original Deepwater acquisition plan would provide and defines the boundaries of a force structure that would satisfy the demand of the USCG's traditional missions and emerging responsibilities. We define such a force structure as being able to maintain 100-percent asset presence. Our force-structure calculations take into consideration asset availability, maintenance, repair, overhaul, training time, etc., during which assets may not be available to perform missions. We call the force structure that is able to maintain 100-percent asset presence the 100-Percent Force Structure.[2]

[1] One RAND objective in conducting the analyses was to avoid overstating asset demand. Because much of the evaluation of performance is subjective and, hence, hard to quantify, we used *asset presence* as a proxy for *performance*—crediting assets with 100-percent effectiveness. Assets are clearly not 100-percent effective, which indeed systematically constrained us from overstating asset demand.

[2] According to a quote in Defense Daily, "the Deepwater contract . . . didn't charge industry with providing a solution that would meet all of [USCG's] goals and targets and 100 percent of [USCG's] missions and 100 percent of the areas that [the USCG is] charged to operate in . . ." (Biesecker, 2004).

RAND pursued this force-structure evaluation by addressing the following five questions:

- Will the originally planned force structure enable the USCG to carry out anticipated missions?
- What force structure would be required to satisfy the demands of traditional missions and emerging responsibilities robustly?
- What are the performance benefits of a 100-Percent Force Structure?
- What is the cost of acquiring a 100-Percent Force Structure?
- Is U.S. industry capable of producing the 100-Percent Force Structure?

Methodology

Both RAND and the Center for Naval Analyses (CNA) have long and broad experience in examining force-structure issues. CNA prepared two reports, one done in 2000 and another completed in 2002, that explored the USCG's Deepwater program in some detail (East et al., 2000; Nordstrom and Partos, 2002). Both reports analyzed whether the USCG will be able to meet future demands for its services with surface and aircraft assets. The 2000 study defined *demand* in terms of asset presence; the 2002 study defined *demand* in terms of force structure. As part of this study, RAND performed an independent evaluation of the methodologies, tools, and data used by CNA in its studies. RAND then built upon those methodologies and data to tailor tools for this study.

CNA generously provided the RAND analysis team with the computer models it developed and used to analyze the issue and the data and assumptions upon which it based its conclusions. RAND reran CNA's calculations and reviewed all of the assumptions that CNA made in preparing its reports. RAND conducted this detailed review of the CNA studies to satisfy itself that the research results obtained by CNA were replicable and that the research paths and conclusions it took were reasonable, which proved to be the case: The

RAND study team concluded that the methodologies, tools, and data CNA used were appropriate and sound.

RAND researchers used the methodologies they confirmed in their detailed review to develop new tools and techniques that allowed them to make additional projections and evaluations of the number of assets a force structure needs so that it can satisfy a particular mission demand. Detailed analysis, accounting for more of the operational constraints, would need to be conducted in order to refine the estimates.

Will Currently Planned Assets Enable USCG to Carry Out Anticipated Missions?

Our first step was to determine whether currently planned assets enable the USCG to carry out anticipated missions. RAND researchers first looked at the demand for traditional missions that were anticipated in 1998, during Deepwater programming. They then looked at the additional responsibilities that have emerged since 1998, including those evolving from the terrorist attacks of September 11, 2001.[3]

Will Currently Planned Assets Meet Traditional Mission Demand?

CNA's 2000 study restricted itself to evaluating the USCG demand on current assets that it assigns to traditional missions, such as Alien Migrant Interdiction Operations (AMIO), Counterdrug (CD), Living Marine Resource Enforcement (LMR), Marine Environmental Protection (MEP), Search and Rescue (SR), and National Defense

[3] Of the effect of these additional responsibilities on force structure, a GAO report notes (U.S. GAO, 2003):

> September 11th drastically changed the Coast Guard's priorities, and it did so by adding to the agency's many responsibilities rather than by replacing responsibilities that were already in place. For example, the recently enacted Maritime Transportation Security Act (Pub. L. 1-7-295, Nov. 25, 2002) made the Coast Guard responsible for numerous new port security functions that will likely require sizable personnel and hardware commitments.

(East et al., 2000). CNA concluded that demand will at least stay constant through 2020, and likely will increase.

By restricting its analysis to assets currently in the fleet, CNA evaluated systems that may not be in service through 2020, which was its study time horizon. The RAND team took a different approach: It focused on the replacement force structure that the Deepwater program intends to acquire. RAND concluded that traditional mission demand for Deepwater assets would outstrip supply. That is, currently planned assets would not meet traditional mission demand.

Will Currently Planned Assets Meet Demands from Emerging Responsibilities?

CNA's 2002 study built on the findings of the 2000 analysis, but carried an important assumption: *that the proposed Deepwater assets would be sufficient to meet USCG's anticipated demand from traditional missions* (Nordstrom and Partos, 2002, p. 24). Based on that assumption, this later study examined emerging responsibilities that the USCG is expected to take on, not just maritime homeland security and homeland defense responsibilities, which it has shouldered since September 11, but others, such as fisheries protection and counterdrug efforts, which have increased. CNA found that these demands from emerging responsibilities tax not only the assets in the USCG's current fleet but also the assets it has earmarked as its replacements through the Deepwater program. In other words, CNA found that the demand for the replacement Deepwater assets will outstrip the supply.

After reviewing CNA's data, approach, and assumptions, and after independently evaluating the data calculations and interpolations used by CNA, the RAND study team concurred with the CNA finding. It agreed with CNA that the USCG's assets would not meet demands from emerging responsibilities.

What Assets Would Be Required to Perform Traditional Missions Robustly?

RAND's second question—What assets would be required to perform the traditional missions robustly?—turns on how policymakers define "robust force." Does *robust* entail a force that is able to cover 100 percent of all the USCG's missions, one that is able to cover 80 percent, or one that is able to cover 60 percent?

The discussion in this chapter concentrates on the force structure needed for 100-percent mission coverage, which we refer to as a *100-Percent Force Structure,* and means that all asset-presence demands are met. Why 100 percent? That level might well have become the de facto mission coverage standard after September 11. For years before then, the USCG, because of chronic underfunding, could not provide total coverage in all mission areas. But that was yesterday. The United States today has a new image of its national interest, and policymakers should not assume that USCG mission-coverage levels that were acceptable in the past remain acceptable for the future.

Even though it concentrated on 100-percent mission coverage, RAND also evaluated other coverage levels. See Appendix D for a discussion of the 60- and 80-percent mission-coverage cases.

Assets Required to Perform 100 Percent of Demands of USCG's Traditional Missions

RAND calculated the air and surface force structure that the USCG would need to acquire through Deepwater to fully meet demand for traditional missions between now and 2020. Here, we define *force structure* as the number of assets it would take to field all the platforms needed to meet mission demands. Our calculations take into consideration availability, maintenance, repair, overhaul, training time, etc., during which platforms may not be available to perform missions. Table 4.1 displays the current Deepwater plan and the estimated force structure that RAND's calculations suggest the USCG will actually need.

Table 4.1
USCG Force Structure Needed to Meet Demands of Traditional Missions: Original Deepwater Plan and RAND Estimate

Assets	Force Structure: In Original Deepwater Plan	Force Structure: Traditional Missions (RAND Estimate)[a]
National Security Cutter (NSC)	8	35
Offshore Patrol Cutter (OPC)	25	36
Fast Response Cutter (FRC)	58	79
Maritime Patrol Aircraft (MPA)	35	29
Long Range Surveillance (LRS) (LRS are renamed HC-130)	6	6
High Altitude Endurance Unmanned Air Vehicle (HAEUAV)	7	21
Vertical Recovery System (VRS)	34	32
Multimission Cutter Helicopter (MCH)	93	118
Vertical Unmanned Air Vehicle (VUAV)	69	85

[a]Needed to provide 100-percent asset presence.

We derived our estimate using the following methodology: Our foundation was the traditional demands for legacy assets that were evaluated by CNA and that are summarized in Appendix D of East et al. (2000). We then converted that demand into demand for Deepwater replacement assets, in two steps. First, we evaluated the ratio of the annual mission-hour availability of a given replacement asset class to the annual mission-hour availability of the corresponding legacy asset class. Second, we multiplied the demand for the given legacy asset class by this ratio. The result was an estimate of the demand for the replacement asset class. The methodology was developed by CNA and is described in detail in the Deepwater Program Office's analysis of legacy assets, which also defined the emerging mission demands for replacement assets (USCG, 2002a).

Our calculations show that the USCG will need a force structure made up of twice the number of major cutters (National Security Cutter and Offshore Patrol Cutter) it spelled out in the Deepwater plan, and more than twice the number of HAEUAVs. We estimate that, if it is able to use HAEUAVs on out-of-area deployments—e.g., to Mexico, Panama, and Western Pacific islands—missions that have required manned aircraft in the past, the USCG may need fewer maritime patrol aircraft than it planned for in the Deepwater program.[4]

Assets Required to Perform 100 Percent of Demands from USCG's Emerging Responsibilities

The CNA-identified USCG force structure for meeting emerging responsibilities is shown in Table 4.2 (Nordstrom and Partos, 2002), which extends Table 4.1 by adding CNA's estimates for emerging responsibilities, in the "Emerging Responsibilities (CNA Estimate)" column. Note that this column shows only force structure needed to meet emerging responsibilities.

To obtain a figure for total force structure, the rightmost column in Table 4.2, we added these CNA estimates to our own estimates of the force structure required to meet traditional mission demands and emerging responsibilities. We term this force structure "the 100-Percent Force Structure."

The RAND study team designed an acquisition schedule for the 100-Percent Force Structure defined in the rightmost column of Table 4.2. This schedule is based on the production start dates and pace used in our 15-year accelerated-acquisition plan, discussed in Chapter Three. The 15-year accelerated-acquisition schedule is a compromise between the 10-year accelerated-acquisition schedule and the original 20-year Deepwater acquisition schedule. We felt that using this midpoint as a basis gave the decisionmaker a good reference point. Using this production tempo, we extended the manufacturing period until 2027, the year in which the last National Security Cutter enters the fleet, eight years after the last air asset enters the fleet. Tables 4.3 and 4.4 list the number of surface assets and air assets, respectively, in service per year under this acquisition schedule.

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[4] The HAEUAVs are flown from airfields at Honolulu, Hawaii; San Diego, Calif.; and Miami, Florida.

Table 4.2
USCG Force Structure Needed to Meet Demands of Traditional Missions and Emerging Responsibilities

Assets	Force Structure			
	In Original Deepwater Plan	Traditional Missions (RAND Estimate)[a]	Emerging Responsibilities (CNA Estimate)[a]	Total[a]
National Security Cutter (NSC)	8	35	9	44
Offshore Patrol Cutter (OPC)	25	36	10	46
Fast Response Cutter (FRC)	58	79	11	90
Maritime Patrol Aircraft (MPA)	35	29	6	35
Long Range Surveillance (LRS) (LRS are renamed HC-130)	6	6	0	6
High Altitude Endurance Unmanned Air Vehicle (HAEUAV)	7	21	4	25
Vertical Recovery System (VRS)	34	32	1	33
Multimission Cutter Helicopter (MCH)	93	118	21	139
Vertical Unmanned Air Vehicle (VUAV)	69	85	38	123

NOTE: This table shows expected levels of maritime homeland security, national defense, and international fisheries protection. It assumes that Deepwater assets will have roughly 50 percent higher availability than current assets. Numbers are rounded to the nearest whole number. RAND estimate source: East et al. (2000), adjusted to reflect more-capable Deepwater assets; CNA estimate source: Nordstrom and Partos (2002, Table 19).

[a]Needed to provide 100-percent asset presence.

Table 4.3
Number of Surface Assets in Service per Year Under the Acquisition Plan for the 100-Percent Force Structure

Year	WHEC	NSC	WMEC	OPC	PB-110	PB-123	FRC	LRI	SRP
2002	12	0	32	0	47	0	0	0	0
2003	12	0	32	0	40	4	0	0	4
2004	12	0	32	0	33	11	0	0	11
2005	12	0	32	0	26	18	0	0	20
2006	11	1	31	0	19	25	0	1	29
2007	10	2	30	1	12	31	1	6	38
2008	9	3	28	3	5	34	5	14	47
2009	6	5	26	5	0	34	11	22	56
2010	3	7	24	7	0	34	17	30	65
2011	1	9	21	10	0	29	23	36	74
2012	0	11	18	13	0	24	29	42	82
2013	0	13	15	16	0	19	35	48	90
2014	0	15	12	19	0	14	41	54	98
2015	0	17	9	22	0	9	47	60	106
2016	0	19	6	25	0	4	53	66	114
2017	0	21	3	28	0	0	58	72	122
2018	0	23	0	31	0	0	63	78	130
2019	0	25	0	34	0	0	68	84	136
2020	0	27	0	37	0	0	73	90	139
2021	0	29	0	39	0	0	78	96	139
2022	0	31	0	41	0	0	82	99	139
2023	0	33	0	43	0	0	85	99	139
2024	0	36	0	45	0	0	88	99	139
2025	0	39	0	46	0	0	90	99	139
2026	0	42	0	46	0	0	90	99	139
2027	0	44	0	46	0	0	90	99	139

Table 4.4

Number of Air Assets in Service per Year Under the Acquisition Plan for 100-Percent Force Structure

Year	HC-130	HH-60J	HH-65	HU-25	VRS	VUAV	MPA	MCH	HAEUAV
2002	30	42	93	27	0	0	0	0	0
2003	30	42	93	27	0	0	0	0	0
2004	30	42	93	27	0	0	0	0	0
2005	29	40	93	20	2	0	9	0	0
2006	29	37	86	16	6	8	12	7	0
2007	29	34	76	13	10	18	15	17	0
2008	26	30	58	10	14	33	18	35	0
2009	25	26	47	5	18	43	22	46	0
2010	24	19	41	0	23	53	26	52	0
2011	14	8	21	0	28	60	30	72	0
2012	6	0	0	0	33	69	35	94	0
2013	6	0	0	0	33	79	35	109	0
2014	6	0	0	0	33	90	35	124	0
2015	6	0	0	0	33	101	35	139	0
2016	6	0	0	0	33	112	35	139	7
2017	6	0	0	0	33	123	35	139	14
2018	6	0	0	0	33	123	35	139	21
2019	6	0	0	0	33	123	35	139	25
2020	6	0	0	0	33	123	35	139	25
2021	6	0	0	0	33	123	35	139	25
2022	6	0	0	0	33	123	35	139	25
2023	6	0	0	0	33	123	35	139	25
2024	6	0	0	0	33	123	35	139	25
2025	6	0	0	0	33	123	35	139	25
2026	6	0	0	0	33	123	35	139	25
2027	6	0	0	0	33	123	35	139	25

HAEUAVs Versus Maritime Patrol Aircraft

Note that in the above 100-Percent Force Structure scenario, the RAND team substituted the use of HAEUAVs for many mission demands that traditionally would have been met by MPA. This decision is controversial. It is fair to say that there are important performance trade-offs to consider. MPA have higher payload capability. They are capable of delivering search-and-rescue equipment, such as rafts and radios, and parts to remote cutters and land bases. It is often suggested that having a man in the loop has its benefits, many of which are difficult to quantify. It has also been suggested that an MPA provides a visible deterrent, whereas an HAEUAV does not—a subjective evaluation that is difficult to quantify. Whether sensors on board an HAEUAV can identify a surface vessel with the same efficiency as a crewmember aboard an MPA is an open question. It is a fact that the Global Hawk HAEUAV has an endurance of around 30 hours, more than three times the MPA's 8-hour flight duration (*Jane's All the World's Aircraft,* 2003; *Jane's Electronic Mission Aircraft 11,* 2003).

Moreover, the Global Hawk HAEUAV is able to operate at altitudes of around 60,000 feet, twice as high as the approximate 30,000-foot ceiling altitude of the Maritime Patrol Aircraft (*Jane's All the World's Aircraft,* 2003; *Jane's Electronic Mission Aircraft 11,* 2003). The higher operating altitude offers substantial benefits for radar and signals intelligence (SIGINT) in horizons and coverage area. The theoretical limits of horizon and coverage area are summarized in Table 4.5, which shows that radar and SIGINT coverage area grow nearly linearly with altitude. For instance, the coverage area for a Global Hawk cruising at 60,000 feet is roughly double that of a Maritime Patrol Aircraft cruising at 30,000 feet, a difference depicted for comparison in Figure 4.1.

Table 4.5
Theoretical Horizon and Coverage Area for Radar and SIGINT at Different Altitudes

Altitude (ft)	Horizon (nmi)	Coverage Area (nmi^2)
10,000	120	45,502
20,000	170	90,970
30,000	208	136,405
40,000	241	181,806
50,000	269	227,173
60,000	295	272,508

Figure 4.1
Theoretical Radar and SIGINT Coverage Area, 30,000-ft Versus 60,000-ft Altitude

RAND MG114-4.1

The performance trades of HAEUAVs for MPA should be examined in further detail before the USCG modifies the number of MPA it plans to acquire for Deepwater.

What Are the Performance Benefits of the 100-Percent Force Structure?

To determine the performance benefits of the 100-Percent Force Structure, the RAND team used the measures of performance—mission hours and detection coverage area of airborne sensors—that it defined in Chapter Three. In addition, it employed two other measures of performance:

- the number of assets needed to protect an individual port at the highest level of alert
- the number of ports that could be protected at the highest level of alert.

USCG has a system of alert levels, called the MARSEC security levels, which are defined in Table 4.6. The highest level of alert is MARSEC III.

Table 4.6
USCG Maritime Security Levels

Aspect	MARSEC I	MARSEC II	MARSEC III
Nature of Threat	General threat against ports, harbors, waterways, and approaches	General non-specific threat based on intelligence or other warning	Incident imminent; response to specific event or intelligence
Anticipated Duration	Indefinite	Nationwide: 15–45 days	Approximately 5–15 days
Scope	Nationwide	Regionally: 15–45 days	Up to two ports
Emphasis	Awareness and preparation	Regionally or nationwide Deterrence and detection	Protection and response

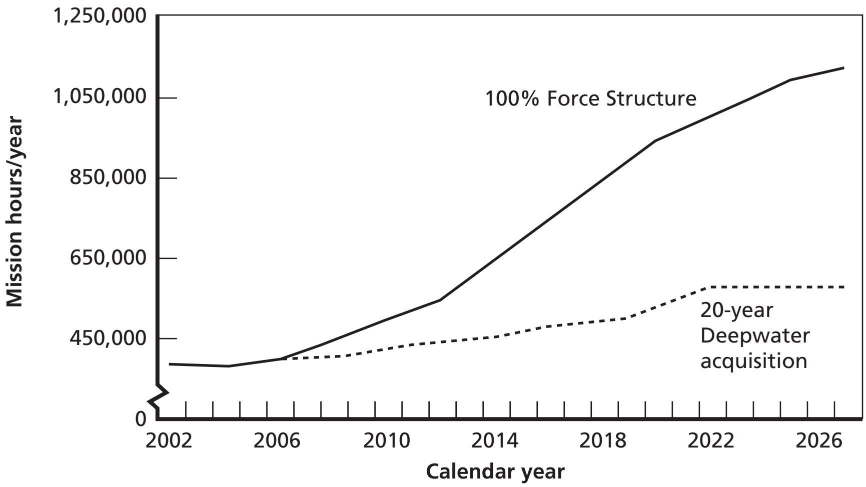
SOURCE: This information was obtained from Table E.2-5 of U.S. Coast Guard, Deepwater Program Office (G-D), *Modeling and Simulation Master Plan (MSMP)*, Washington, D.C., Version 1.0, 2001.

Mission-Hour Performance

Recall that in Chapter Three we discussed annual mission hours for legacy and replacement assets. Table 3.6 (mission hours for legacy assets) and Table 3.7 (mission hours for replacement assets) listed the number of mission hours that each air and surface asset is expected to be available for mission use per year.

Figure 4.2 sums those numbers into annual mission-hour totals for two fleets: one made up of surface and air assets that would be acquired under the 20-year Deepwater acquisition (bottom curve) and another made up of surface and air assets that would satisfy the needs of the 100-Percent Force Structure (top curve). Observe that with the 100-Percent Force Structure, mission-hour performance

Figure 4.2
Annual Surface and Air Mission Hours for the 100-Percent Force Structure and the 20-year Deepwater Acquisition



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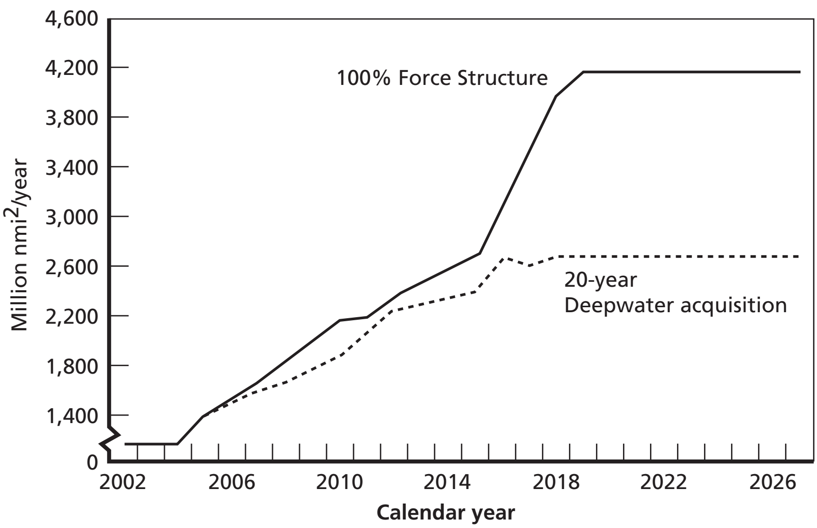
benefits would begin in 2005 and exceed the maximum mission-hour performance of the Deepwater plan in 2012. The annual number of mission hours for this force structure will reach 1.13 million by 2027, which is a 93-percent increase over the annual mission hours that the fleet acquired under the 20-year Deepwater plan would provide.

Detection Coverage Area of Airborne Sensors

Recall also that in Chapter Three we discussed detection coverage areas for legacy and replacement assets. Table 3.8 (detection coverage area for legacy assets) and Table 3.9 (detection coverage area for replacement assets) listed the mission area that each air and surface asset is expected to cover per year.

As we did for mission hours in the preceding discussion, in Figure 4.3 we summed Chapter Three's numbers into annual totals

Figure 4.3
Annual Square Nautical Miles Covered by Airborne Sensors in the 100-Percent Force Structure and the 20-Year Deepwater Acquisition



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of detection coverage area for two fleets: one made up of surface and air assets that would be acquired under the 20-year Deepwater acquisition (bottom curve) and another made up of surface and air assets that would satisfy the needs of the 100-Percent Force Structure (top curve). The figure shows that, with the 100-Percent Force Structure, performance benefits in detection coverage area would begin in 2005 and start to exceed the maximum coverage-area performance of the Deepwater plan in 2016. The annual detection coverage area for this force structure will reach 4.2 billion nmi^2 per year by 2019, a 54-percent jump from the detection coverage area that a fleet acquired through the original 20-year Deepwater program would offer.

The Number of Assets Needed to Protect One Port Under MARSEC III

Notional deployment packages for Deepwater maritime homeland security for each MARSEC level are summarized in Table 4.7. Note that this table refers to Tier One Ports, which are also referred to in the literature (e.g., USCG, 2002b) as Military and Economically Strategic Ports. These ports are listed in Table 4.8.

The Deepwater Program Office has specified the types and numbers of assets required to provide protection of one port under MARSEC III conditions (USCG, 2002b, Appendix E, Section E.2.2), which are summarized in Table 4.9.

Table 4.7
Notional Deepwater Force Package Assignments for Maritime Homeland Security

MARSEC Level	Flight Deck–Equipped Cutters (FDEC)[a]	Fast Response Cutter (FRC)	Helicopters	Fixed-Wing Aircraft
I	One FDEC must be within 24 hours' response of all specified ports; one FDEC may be assigned to multiple ports	One FRC assigned to ports requiring extended transits	Each FDEC will require a fully operational helicopter; routine surveillance flights of specified port areas and port approaches will be required	Routine wide-area surveillance of offshore areas is required
II	One FDEC assigned to Tier One ports	One FRC assigned to Tier One ports	Each FDEC will require a fully operational helicopter; regular surveillance of specified port areas and approaches	Regular surveillance of specified port approaches and offshore areas
III	One FDEC assigned to each specified port	One FRC assigned to each specified port	Each FDEC will require a fully operational helicopter; near-continuous surveillance of the specified port areas and approaches	Near-continuous surveillance of the specified port approaches and offshore areas

SOURCE: This information was obtained from Table E.2.6 of U.S. Coast Guard, Deepwater Program Office (G-D), *Modeling and Simulation Master Plan (MSMP)*, Washington, D.C., Version 2.0, 2002b.

[a]Flight deck–equipped cutters—the National Security Cutter and the Offshore Patrol Cutter—are helicopter-capable.

Table 4.8
Militarily and Economically Strategic Ports

Atlantic Area	
Baltimore, MD & Washington, DC	New London, CT
Baton Rouge, LA	New Orleans/Port of South Louisiana
Boston, MA	New York/New Jersey
Buffalo, NY	Norfolk/Newport News, VA
Charleston, SC	Panama City & Port St. Joe, FL
Chicago, IL	Pascagoula, MS
Cincinnati, OH	Pensacola, FL
Cleveland, OH	Philadelphia, PA
Corpus Christi, TX	Pittsburgh, PA
Detroit, MI	Port Arthur/Beaumont, TX
Duluth, MN & Superior, WI	Port Canaveral, FL
Galveston/Texas City/Freeport, TX	Portland, ME
Houston, TX	Portsmouth, NH
Huntington, WV	Providence, RI
Jacksonville, FL & Kings Bay, GA	San Juan, PR
Lake Charles, LA	Savannah, GA
Louisville, KY	St. Louis, MO
Memphis, TN	Tampa/Port Manatee, FL
Miami, FL	Toledo, OH
Mobile, AL	West Palm Beach, FL
Morehead City, NC	Wilmington, DE
Morgan City, LA	Wilmington, NC & MOT Sunny Point
New Haven, CT	
Pacific Area	
Anchorage, AK	Port Hueneme, CA
Guam	Portland, OR & Vancouver, WA
Honolulu, HI & Pearl Harbor, HI	San Diego, CA
Los Angeles/Long Beach, CA	Seattle/Tacoma, WA
MOT Concord (MOTCo)	Valdez, AK
San Francisco/Oakland/Richmond, CA	

NOTE: MOT = Military Ocean Transport.

Table 4.9
Mix of Assets Required to Protect One Port Under MARSEC III Conditions

Assets	Quantity
Major Cutter: National Security Cutter or Offshore Patrol Cutter	1
Fast Response Cutter	1
Maritime Patrol Aircraft	5
Multimission Cutter Helicopter	3
Vertical Unmanned Air Vehicle	4

Again drawing from CNA calculations (Nordstrom and Partos, 2002, p. 28), we summarize the availability of assets that the USCG plans to operate in deepwater environments, in Table 4.10. The data show that the Maritime Patrol Aircraft availability is 0.89, meaning that, on average, 89 percent of the Maritime Patrol Aircraft owned by the USCG are expected to be available for mission use at any given time. The remaining Maritime Patrol Aircraft are unavailable for mission use for a variety of possible reasons, such as training, maintenance, or refurbishment.

To determine the number of ports that Deepwater assets might be able to protect, RAND researchers multiplied the number of each type of asset available in each force mix by the corresponding availability rate in Table 4.10, then divided the result by the corresponding number of assets needed to protect a port under MARSEC III conditions, listed in Table 4.9. For example, both the original 20-year Deepwater plan and the 100-Percent Force Structure require 35 MPA. From Table 4.10, we see that the availability rate is 0.89, and from Table 4.9 we see that five MPA are needed to protect one port under MARSEC III conditions. The result of this calculation ($[35 \times 0.89]/5 = 6.23$) is that the USCG's MPA force structure is adequate to protect six ports under MARSEC III conditions.

Table 4.10
Fraction of Asset Availability

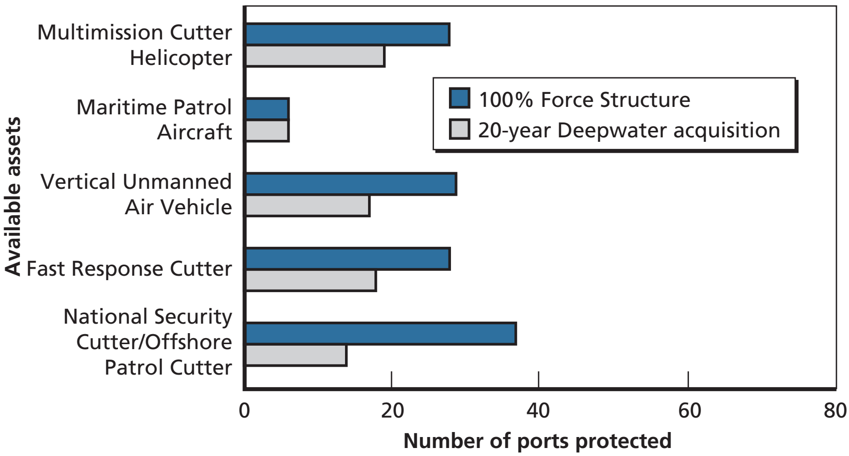
Assets	Availability
Major Cutter: National Security Cutter or Offshore Patrol Cutter	0.42
Fast Response Cutter	0.32
Maritime Patrol Aircraft	0.89
Multimission Cutter Helicopter	0.88
Vertical Unmanned Air Vehicle	0.96

Figure 4.4 shows the result of this same calculation for all Deepwater assets assigned to protecting ports. It shows that, at most, six ports may be protected under MARSEC III conditions with either the Deepwater or the 100-Percent Force Structure. The limiting factor is the number of MPA. In contrast, enough FRCs are in the 100-Percent Force Structure to provide protection to 28 ports under MARSEC III conditions. This finding suggests that there is a potential for the USCG to increase the number of ports that may be protected by developing operational concepts that are less dependent on Maritime Patrol Aircraft. For instance, the USCG might consider substituting UAVs to cover the role of MPAs in port protection or substituting flight deck–capable surface assets.

Note that these estimates are for a best-case scenario. They ignore many critical constraints, such as the ability of the USCG to quickly relocate assets to the ports that need protection.

The RAND study team also estimated the number of ports that could be protected under MARSEC III conditions if the availability of assets were increased from the levels specified in Table 4.10—that is, the number of ports under the assumption that asset availability could be "surged"—made up to two times the standard availability rate, with a topmost limit of 100-percent availability. The standard and surged availability rates used by the RAND team are summarized

Figure 4.4
Number of Ports That Can Be Protected Under MARSEC III Conditions: Standard Asset Availability Rates in Table 4.10



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in Table 4.11. Figure 4.5 is similar to Figure 4.4, but shows the surged availability rates instead of the standard availability rates. We see that the maximum number of ports that could be protected by MPA under MARSEC III conditions increases from six to seven if the availability rates are surged. Again, the limiting factor is the number of MPA.

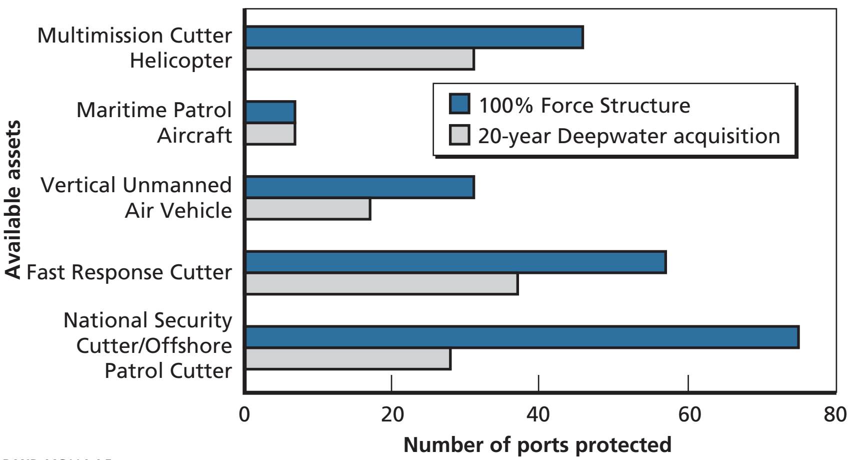
In summary, little is to be gained in port protection by surging asset availability.

Note that the decision of the RAND team to substitute HAEUAVs for Maritime Patrol Aircraft for some missions limits the number of ports that can be protected under MARSEC III conditions. Using additional Maritime Patrol Aircraft instead of HAEUAVs would have the benefit of increasing the number of ports that could be protected. The USCG may also want to explore alternative concepts of operations to see if HAEUAVs could perform

Table 4.11
Standard and Estimated Surged Asset-Availability Rates

Assets	Standard Availability	Surged Availability
Major Cutter: National Security Cutter or Offshore Patrol Cutter	0.42	0.84
Fast Response Cutter	0.32	0.64
Maritime Patrol Aircraft	0.89	1.0
Multimission Cutter Helicopter	0.88	1.0
Vertical Unmanned Air Vehicle	0.96	1.0

Figure 4.5
Number of Ports That Can Be Protected Under MARSEC III Conditions: Surged Asset-Availability Rates



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the role of Maritime Patrol Aircraft in protecting ports under MARSEC III conditions.

The 100-Percent Force Structure would produce several tangible and potential performance benefits. It would

- be capable of performing 100 percent of traditional and emerging missions
- provide more mission hours than the force acquired through the original 20-year Deepwater plan, beginning in 2005, and would exceed that Deepwater force's maximum mission performance by 2012
- provide greater airborne sensor coverage than the force acquired through the original 20-year Deepwater plan, beginning in 2005, and would exceed that Deepwater force's maximum airborne sensor coverage performance by 2016.

At the same time, it should be noted that under its present operational concepts, the USCG would not be able to cover more ports under MARSEC III with the 100-Percent Force Structure than it would with the original Deepwater plan's force structure. Nonetheless, if it were to develop operational concepts that are less dependent on MPAs, the USCG could employ this force structure as a potential strategy to increase the number of ports it could protect during conditions of high maritime security alert.

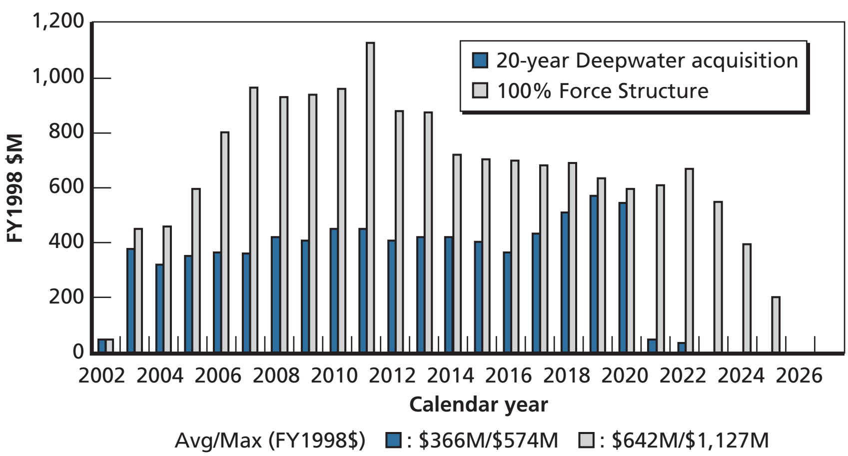
What Is the Cost of Acquiring the 100-Percent Force Structure?

To determine the cost of acquiring the 100-Percent Force Structure displayed in the right column of Table 4.2, the RAND team looked at two types of cost streams: acquisition and operating and support. It should be emphasized that the RAND team estimated only the cost of acquiring the surface and air assets outlined in Table 4.2. RAND did not consider the costs associated with facilities to support these assets, recruiting and training costs, or other cost factors, all of which were outside the scope of this study and could not be accommodated within the time limitations.

Acquisition Costs

Figure 4.6 shows the annual cost streams (in FY1998 dollars) to acquire the surface and air assets in the 20-year Deepwater acquisition plan and in the 100-Percent Force Structure. The total cost of acquiring the original Deepwater plan's surface and air assets over 20 years is $7.7 billion, less than half the $16.2-billion cost of acquiring such assets in the 100-Percent Force Structure. Annually, the original Deepwater acquisition plan's outlays would average $366 million rather than the $624 million for our proposed force structure. The original Deepwater acquisition plan's annual outlays would top out at $574 million in 2020; the 100-Percent Force Structure's outlays would top out at a higher annual level, $1.13 billion, and at an earlier date, 2012.

Figure 4.6
Annual Cutter and Aircraft Acquisition Costs, 2002–2027:
20-Year Deepwater Acquisition and 100-Percent Force Structure



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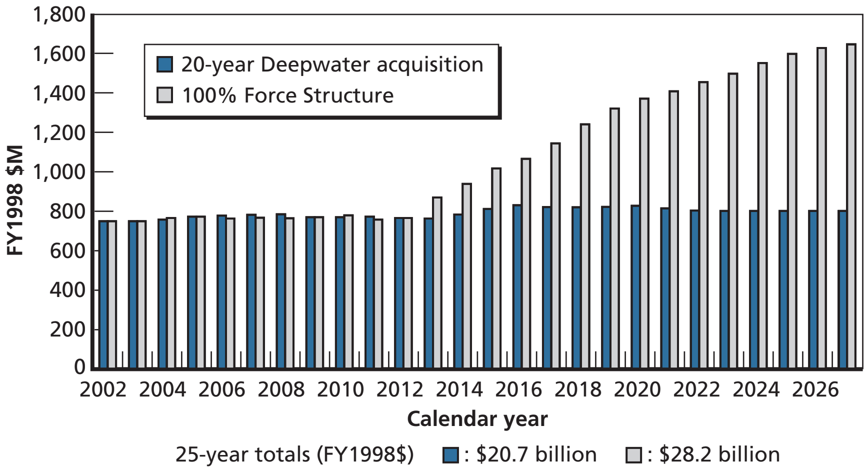
Operating and Support Costs

Figure 4.7 shows a similar picture (again in FY1998 dollars) for operating and support expenditures of the 20-year Deepwater acquisition plan and the 100-Percent Force Structure. Whereas operating and support costs connected with the 20-year Deepwater acquisition plan remain relatively constant over the next two decades, those connected with the 100-Percent Force Structure would begin to climb significantly in 2014. The total cost of operating and supporting the original Deepwater plan's surface and air assets over 25 years is $20.7 billion, more than a third less than the $28.2-billion cost of operating and supporting the assets in the 100-Percent Force Structure. Most of that cost difference comes in the latter years; by 2027, the year that acquisitions are complete, operating and support costs for the 100-Percent Force Structure could hit $1.66 billion a year, more than

Figure 4.7
Annual Cutter and Aircraft Operating and Support Costs, 2002–2027: 20-Year Deepwater Acquisition and 100-Percent Force Structure



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double the $808 million that the 20-year Deepwater acquisition plan assets would require.

In summary, the costs (in FY1998 dollars) of acquiring and of operating and supporting this force structure rather than the 20-year Deepwater acquisition plan are as follows:

- Total acquisition costs would more than double over the life of the program, rising to $16.2 billion from $7.7 billion. These costs would not include facility upgrades, recruiting, or training.
- Annual operating and support costs would ultimately more than double; by 2027, the year that acquisitions are complete, operating and support costs could hit $1.66 billion a year, more than double the $808 million that the 20-year Deepwater acquisition plan assets would require.
- Total operating and support costs over the period 2002 to 2027 would increase by more than a third, rising to $28.2 billion from $20.7 billion.

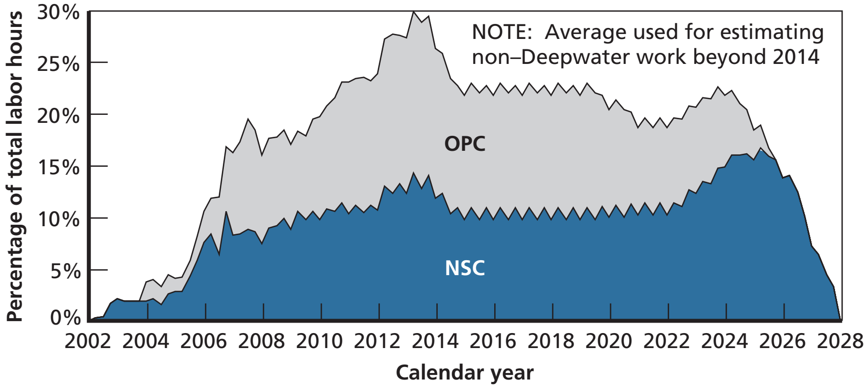
Is U.S. Industry Capable of Producing the 100-Percent Force Structure?

To gauge whether the U.S. shipbuilding and aircraft industrial bases would be capable of producing the assets in the 100-Percent Force Structure, the RAND team looked at two measures of industrial capability: labor hours and production capacity.

Labor-Hour Implications for Shipbuilders

As discussed in Chapter Three, the NSC and OPC are being supplied by Northrop Grumman Ship Systems. Figure 4.8 shows the percentage of total shipyard labor hours at Northrop Grumman devoted to the National Security Cutter and Offshore Patrol Cutter under the acquisition schedule for the 100-Percent Force Structure. It indicates that the USCG work would demand up to 30 percent of Northrop Grumman shipyard labor hours. Although higher than the 15 percent

Figure 4.8
Work on the 100-Percent Force Structure at Northrop Grumman Ship Systems, 2002–2027



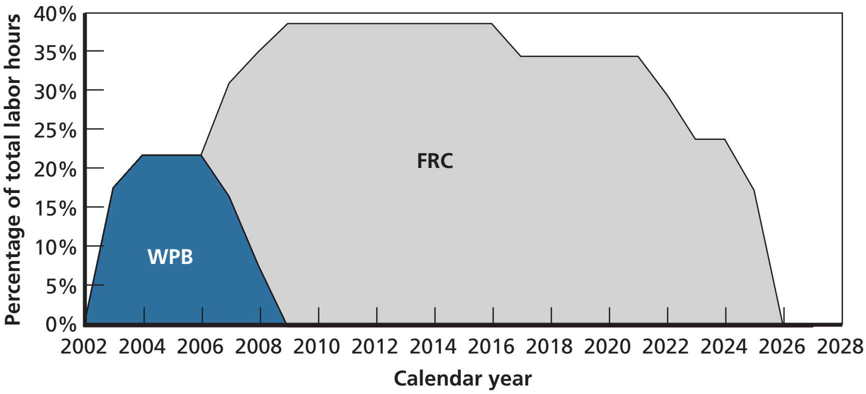
RAND *MG114-4.8*

of shipyard labor hours predicted for the 20-year Deepwater acquisition plan, this amount is not expected to stress the shipyard labor requirements in a significant way, and no facility upgrades are necessary to support the acquisition schedule for this force structure. Note that this figure corresponds to the combined labor requirements for the Avondale and Pascagoula shipyards of Northrop Grumman Ship Systems.

Under the 20-year Deepwater acquisition plan, Bollinger Shipyards is lengthening 49 WPB vessels from 110 feet to 123 feet. Under the acquisition schedule for the 100-Percent Force Structure, that number of conversions decreases to 34 as a result of the more-rapid introduction of FRCs, which ultimately replace the WPBs. Bollinger, in partnership with Halter shipyards, also is supplying the FRCs. Each yard will produce 45 of these vessels in this force structure, for a total of 90. Under the 20-year Deepwater acquisition plan, they would produce a total of 58 (29 each).

Figure 4.9 depicts the percentage of total shipyard labor hours at Bollinger devoted to WPB conversions and FRC construction under the 100-Percent Force Structure acquisition schedule. Note that

Figure 4.9
RAND's Calculated 100-Percent Force Structure Work at Bollinger Shipyards, 2002–2027



NOTE: 2-year average used for estimating all non–Deepwater work.

RAND *MG114-4.9*

RAND used an average of the work over a two-year period[5] in order to estimate all non–Deepwater work. The figure shows that the WPB conversions represent about 22 percent of Bollinger's total labor hours; FRCs can account for as much as 37 percent of its total labor hours. However, the total number of labor hours at Bollinger should rise, given the greater number of Fast Response Cutters that it may build.

Capacity Implications for Air-Vehicle Manufacturers

The RAND team discussed the implications of acquisition schedule for the 100-Percent Force Structure with the major manufacturers of air assets: Eurocopter for the MCH, CASA for the MPA, Agusta/Bell for the VRS, and Bell Helicopter for the VUAV. RAND researchers worked with each manufacturer to identify the maximum annual deliverable capacity possible and to determine the start year in which the maximum deliverable capacity applies.

[5] We were able to gather data for only two years; hence, our average is over those two years.

As with our analysis of options to accelerate Deepwater, much of the data that we obtained are proprietary and thus cannot be displayed in this report. However, we again shared these data sets and our detailed analysis with the USCG. In general, these data convinced us that these manufacturers possess sufficient capacity to supply the maximum number of air vehicles that the 100-Percent Force Structure acquisition plan will need in any given year.

In summary, the implications of this force structure for the shipbuilding and air-vehicle industrial base are as follows:

- No major facility upgrades would be required for any of the manufacturers to accommodate the acquisition schedule.
- Manufacturers of surface and air assets can manage anticipated workloads connected with acquiring this force structure.
- The increased demand in labor hours for the Fast Response Cutter would likely benefit the industrial base at Bollinger and Halter shipyards.

100-Percent Force Structure Bottom Line: Meets Demands of Traditional Missions and Emerging Responsibilities, but at Higher Costs

The RAND team determined that the force structure that would be acquired through the 20-year Deepwater plan would not provide adequate assets to meet traditional mission demands. It also concluded that the contemplated force structure would not meet demands from emerging responsibilities. The 20-year Deepwater acquisition plan would provide only half of the surface assets and two-thirds of the air assets required to meet demands of traditional missions and emerging responsibilities at the 100-percent coverage level.

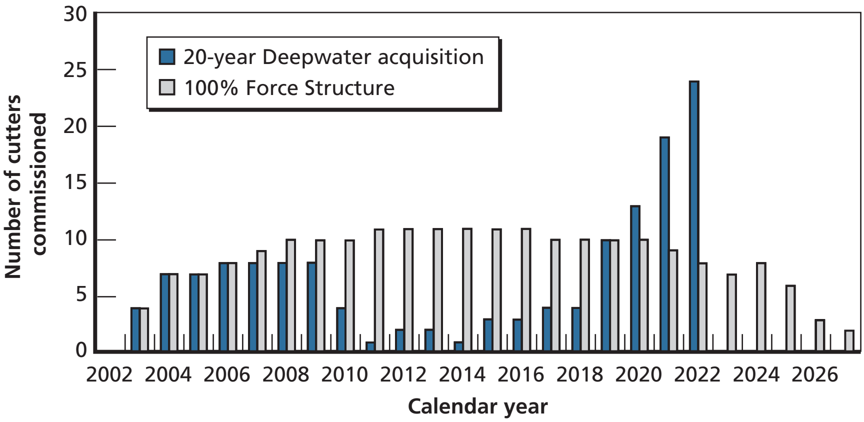
From this determination, we developed the so-called 100-Percent Force Structure, whose assets would enable the USCG to cover 100 percent of demands of traditional missions and emerging responsibilities. This force structure could be completely in place by 2027, but it would cost roughly twice as much as the 20-year Deepwater acquisition plan to acquire and a third more to operate and support. Its total acquisition costs come to $16.2 billion (in FY1998 dollars), not including costs associated with USCG facility upgrades, recruiting, or training. Its annual operating and support costs resemble the 20-year Deepwater plan costs until 2014; thereafter, its operating and support costs begin to climb more steeply, reaching $1.66 billion in 2027, a level that is roughly double the 20-year plan's operating and support costs that year.

Postscript Question One: Can the USCG Integrate the 100-Percent Force Structure?

The introduction of a large number of new assets may have implications for the USCG beyond the scope of the RAND study. For example, to integrate the assets of the total force structure, existing facilities may need to be upgraded and additional facilities constructed. As well, there could be implications for personnel recruitment and training.

The pace of commissionings may challenge USCG's ability to integrate the 100-Percent Force Structure. Figure 4.10 shows the number of cutters commissioned in each year for the period 2002 through 2027 under the original 20-year acquisition schedule and the acquisition schedule for the 100-Percent Force Structure. In the 20-year Deepwater acquisition plan, there is a rapid rate of commissionings in the latter years as the Fast Response Cutter are introduced at a high rate. In the 100-Percent Force Structure acquisition scenario, the USCG would be commissioning 10 cutters a year for over a decade.

Figure 4.10
Cutters Commissioned per Year, 2002–2022:
20-Year Acquisition Schedule and the 100-Percent Force Structure Acquisition Schedule



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Postscript Question Two: Is Buying More of the Same Assets the Best Strategy?

For some missions, buying more of the same types of assets may be the only viable alternative. However, the RAND team believes that the USCG should investigate alternatives to meet demands of each traditional mission and emerging responsibility. For example, the USCG may be able to reduce its reliance on National Security Cutters by acquiring offshore platforms from which operations can be staged. As another example, the USCG might consider using high-endurance airships for long-range surveillance tasks that would otherwise be performed by traditional aircraft. These alternatives would require the USCG to develop new concepts of operation to meet the demands of traditional missions and emerging responsibilities.

CHAPTER FIVE

Findings and Recommendations

As originally conceived, the USCG's Deepwater program aims to slowly, but steadily, replace or modernize nearly 100 aging cutters and upwards of 200 aircraft, by 2022. Upon completion, the program will provide the USCG with a twenty-first century fleet of cutters, aircraft, helicopters, and unmanned air vehicles, linked by state-of the-art command, control, communications, and computing networks and sustained by an integrated logistics system. But, "while the new systems being acquired under Deepwater would be substantially more capable than the legacy systems being retired, the original objective was to maintain the status quo in terms of overall capability, so fewer new assets would be needed . . ." (Biesecker, 2004).

Deepwater was conceived and put in motion well in advance of the changes in the USCG's missions and organizational alignment brought on by the terrorist attacks of September 11, 2001. Whether the program as originally conceived remains valid for the USCG's post-9/11 world was the subject of this study. Motivated by concerns voiced recently in Congress and elsewhere in the policy community ("Senators Urge White House to Speed Up Deepwater," 2003; "Coast Guard Applying Unexpected $168 Million to Deepwater Program," 2003), the USCG sought RAND's help in addressing two related questions: What would be the implications of accelerating the Deepwater program so that assets could be acquired more quickly than the 20-year schedule laid out in the original plan? and Will the program provide the USCG with the assets it needs to perform traditional missions and emerging responsibilities?

Findings

The RAND team derived the three main findings spelled out below from its analysis of the implications of accelerating Deepwater and the assets the USCG will need to perform its traditional missions and emerging responsibilities.

I. The Deepwater Program Can Be Accelerated

As detailed in earlier chapters, the RAND study team found that the original 20-year Deepwater acquisition schedule could be accelerated. In particular, the team concluded the following:

- Acquisitions spelled out in the Deepwater program can be accelerated, either by starting the production of assets earlier or by building them at faster paces.
- Manufacturers of Deepwater cutters, manned aircraft and helicopters, and unmanned air vehicles can accommodate accelerated-acquisition schedules that compress production of the assets into 15-year or 10-year periods.
- Compared with the original 20-year acquisition schedule, alternative 15-year or 10-year acquisition schedules would

  —not change total acquisition or operating and support costs
  —increase annual acquisition and operating and support costs
  —enable the USCG's cutters to operate for more mission hours and its air vehicles to monitor more square nautical miles.

II. The Deepwater Program Provides Inadequate Assets for USCG's Traditional Missions and Emerging Responsibilities

While the RAND team found that the Deepwater program could be accelerated, it also found that the assets slated to be acquired through Deepwater would be inadequate to meet the USCG's traditional missions and emerging responsibilities, regardless of the schedule the USCG uses. Specifically, RAND found that

- the Deepwater program as originally conceived will not provide the USCG with an adequate number or array of cutters and air vehicles to meet the demands imposed by its traditional missions and emerging responsibilities. The program provides only

  —50 percent of needed surface assets
  —67 percent of needed air vehicle assets.

III. An Alternative Force Structure Can Provide Adequate Assets for USCG's Traditional Missions and Emerging Responsibilities

To overcome the shortcomings of the Deepwater program's original asset mix, the USCG will need a significantly larger force structure. The RAND team identified such a force structure, dubbed the 100-Percent Force Structure, that would be made up of twice as many cutters (180 versus 91 in the original Deepwater acquisition plan), nearly twice as many high-altitude or vertical unmanned air vehicles (148 versus 76), and 50 percent more multi-mission cutter helicopters (139 versus 93). On the basis of its analysis of the USCG's expected requirements and responsibilities, RAND found that

- this force structure would provide 100 percent asset presence, thereby allowing the USCG to satisfy the demand for all traditional missions and emerging responsibilities.
- compared with the force structure that the USCG would acquire under the original 20-year acquisition schedule, this force structure would enable the USCG to

  —operate its cutters for more mission hours and to have its air vehicles monitor more square nautical miles. These benefits would begin to accrue as early as 2005 and would exceed the original force structure's maximum performance by 2016
  —protect more ports under highest-alert security (MARSEC III) conditions, provided that the USCG develops operational concepts that are less dependent on MPA.

- this force structure would cost \$16.2 billion (in FY1998 dollars) to acquire, an increase of \$8.5 billion from the cost of acquiring assets in the original 20-year Deepwater schedule.
- America's shipbuilding and aircraft industrial bases could accommodate building the assets included in the 100-Percent Force Structure.

Recommendations

Based on the above findings, we recommend that the USCG pursue a two-pronged strategy. The USCG should meet its mission demands by (1) accelerating and expanding the asset acquisitions in the current Deepwater program and, at the same time, (2) identifying and exploring new platform options, emerging technologies, and operational concepts that could leverage those assets. Such a two-pronged strategy may satisfy demand more quickly and at less cost than just expanding the original Deepwater plan.

With respect to accelerating Deepwater acquisitions, it should be noted that both of the acceleration schedules we examined—the 15-year and the 10-year—are feasible. However, it was beyond the scope of this study to assess the ability of the USCG to integrate assets it would acquire using either of those schedules. Without that assessment, we are reluctant to make a recommendation on whether to go with a 15-year or a 10-year acquisition schedule. Nonetheless, it stands to reason that, because the 15-year schedule would require a less rapid introduction of new equipment, it might prove to be a less risky course of action. As a result, we conclude that the assets acquired under that schedule likely will be easier for the USCG to integrate.

With respect to expanding Deepwater acquisitions, we recommend that policymakers use the 100-Percent Force Structure that we identified as a benchmark against which alternative concepts can be compared. The RAND team conceived of the proposed force structure as a baseline that USCG leaders can use to explore alternative options to provide the same presence and perform the same missions at less cost.

At the same time, we recommend that USCG leaders continually reassess how to achieve the organization's goals and missions. While we recommend that the USCG accelerate Deepwater and buy more assets than in the current plan, we also recommend that USCG leaders bear in mind that buying more of today's assets may not provide optimal results.

The USCG could, for example, employ offshore rigs, airships, or emerging UAV concepts to accomplish some of the missions currently handled by traditional assets. Placing rigs near sea-lanes may enable USCG to base and sustain surface and air assets in deepwater environments while lessening its traditional reliance on cutters. Employing airships or relying more heavily on UAVs, particularly those able to stay aloft for long periods and cover significant territory, may allow the USCG to leverage its surveillance, reconnaissance, and search and rescue capabilities.

Such alternatives may involve less-costly assets than platforms the USCG currently uses to accomplish missions. How and with what assets the USCG accomplishes traditional missions and emerging responsibilities is an open question. We have identified the force-structure capabilities that we believe the USCG will need in the future, but it is clear that the 100-Percent Force Structure we spelled out is by no means the only way to reach those capabilities. However, relying on acquisitions spelled out in the Deepwater program, either in its original 20-year incarnation or in the 15-year and 10-year accelerations, will not provide the number and array of capabilities the USCG will need in the future.

APPENDIX A

Definitions of U.S. Coast Guard Mission Responsibilities and Cutters

Definition of Mission Needs

The following paragraphs describe what we refer to in this document as "mission responsibilities." They are taken from U.S. Coast Guard, *Mission Need Statement for the Deepwater Capabilities Project,* Washington, D.C., May 3, 1996, pp. 6–8 (available on the Web at *http://www.uscg.mil/deepwater/.*

> **Mission Need.**
>
> Most USCG Deepwater missions can be broken down into the functional tasks of target detection, classification or sorting into targets of interest (TOIs), specific target identification, and prosecution. In order for the USCG to retain its multi-mission flexibility, a capability in unison with the Department of Transportation's goal for strategic utilization of public resources, the ability of our Deepwater assets to execute all of these basis functional tasks is essential. The functional tasks vary depending on the specific target type and the nature of the mission as outlined below.
>
> **Drug Interdiction.** The key requirements for successful drug interdiction are surveillance and presence in areas where the possibility of contraband smuggling exists. The capability to respond to intelligence information and known incidents of [drug] smuggling such as air drops or mother ship rendezvous as they occur is required for this activity. The ability to maintain a continuous on scene presence, thus providing a visible deterrence to

the smuggler, and to dispatch boarding teams to conduct inspections are important mission requirements. Our law enforcement assets must have the ability to compel compliance with USCG law enforcement authority.

Alien Migration Interdiction Operations. Proactive patrols are required to counter the normal flow of illegal migrants. These patrols require surveillance of assigned areas where suspected illegal migration may occur, ant the capability to dispatch boarding teams to suspect vessels and subsequently escort these vessels depending on the final disposition of each case. Additionally, assets must respond to intelligence or operational sightings. Assets must be capable of sustained presence on scene, and must have the capability to rescue a large number of people simultaneously in the event that the typical unseaworthy or overloaded migrant craft sinks or capsizes during the attempted voyage. Ordinarily, assets must provide food and shelter to large number of people when migrants must be removed from their conveyance until final disposition.

Living Marine Resource Enforcement. To meet the objectives of this program, it is necessary for the USCG to project a continuous enforcement presence throughout the U.S. EEZ and along its boundary, [as well] as in international areas of interest to the U.S. This presence must have the capability to deter illegal or unauthorized activity by documenting violations through vessel boardings and inspections.

General Law Enforcement. The prosecution of this mission requires both proactive patrolling and a reactive response to intelligence information that may be received. The current scope of the operations is minor and the pro-active portion of the mission is conducted frequently as a secondary outcome of a fisheries, AMIO or counter drug patrol. The response to specific intelligence is handled on a case by case basis according to the reliability of the information and availability of an asset. As with all law enforcement missions, our assets must have the ability to compel compliance with Coast Guard law enforcement authority.

Deepwater Search and Rescue. The ability for assets to search for and locate distressed mariners and recover them from positions of peril; provide medical advice, assistance, or evacuation;

and when necessary, provide subjects safe transport to shoreside locations are the primary requirements of the mission. As a secondary priority, Coast Guard SAR assets may attempt to recover or control damage to distressed vessels and other property. Such assistance may consist of controlling or terminating flooding, fire fighting, dewatering, providing mechanical assistance, and towing of stricken vessels.

International Ice Patrol. The Coast Guard is responsible to provide for ice observation and broadcast of shipping advisories whenever the presence of icebergs threaten the shipping routes. The threat typically exists from February through July, but conditions vary annually and operations commence as conditions require. The Coast Guard is responsible for those ice regions of the North Atlantic Ocean through which the major trans-Atlantic shipping tracks pass.

Data Buoy Support. The Coast Guard is responsible to provide for maintenance of NDBC buoys, and also establishes most new buoys and transports relieved buoys to maintenance facilities. This service is almost always conducted with NDBC technicians present. Requirements of this activity include transportation of technicians to buoys and the ability to provide maintenance and industrial support. Assets also must establish real time communications links with NDBC's data network to validate data being transmitted by the buoy. Finally transportation of replacement buoys to and from station is required.

General Defense Operations. The capability to perform surveillance, visit, board, search and seize (VBSS), limited unit defense under a system akin to today's developing Cooperative Engagement Capability system, and provide berthing and logistics support for additional personnel are partial requirements of this activity. Assets must be capable of operating worldwide with sustained presence in the area of responsibility. Interoperability with DOD and other friendly forces, through a system like the present Joint Tactical Information Distribution System (JTIDS/Link-16), is essential.

Maritime Interception Operations. Assets are required to conduct thorough surveillance of an assigned area of responsibility, detect and intercept all shipping, and dispatch trained boarding or inspection teams, providing for their logistics, support, transportation, and protection. Sustained presence in the operating area is a necessity, as is the ability to compel compliance with Coast Guard orders and instructions. Interoperability with other friendly forces is essential to the success of this mission.

Deployed Port Operations, Security and Defense Mission. Conduct thorough surveillance of an assigned area of operations, dispatch appropriate assets to investigate any threat to security, and respond to threats directly or indirectly. Interoperability with other friendly forces and waterside protection of port facilities are necessary capabilities, and assets must be capable of sustained presence.

Environmental Defense Operations. Requirements are yet to be determined [; however,] interoperability and ability to transport crews to the scenes of environmental incidents are certain requirements. Some oil spill or containment capability will also likely be a requirement.

MARPOL Enforcement. To date, this new mission has been prosecuted only on an ad hoc basis. Dedicated surveillance operations employing shore based aircraft, and occasionally patrol boats, have been conducted in the Florida Straits, Gulf of Mexico, and off the California coast. Surveillance coupled with a limited surface presence seems to be the most efficient means of conducting this task.

Lightering Zone Enforcement. The Oil Pollution Act of 1990 restricts oil tankers not equipped with double hulls from many U.S. ports, thus requiring such vessels to [load] cargo in off shore lightering zones. The basic requirement of the Coast Guard's Lightering Zone Enforcement mission is the capability to surveil lightering zones and conduct inspections as necessary. Seventy-four percent of the nation's crude oil imports were received in Gulf of Mexico ports, and twenty-nine percent of this was lightered.

Foreign Vessel Inspection. Surveillance of operating areas and the ability to conduct at sea inspections are the basic requirements of this mission. This mission is not currently conducted in the Deepwater environment.

Definition of USCG Cutters

The following text was taken from the USCG website (*http://www.uscg.mil/hq/g-cp/history/faqs/Designations.html;* accessed November 21, 2003).

What Is a Cutter?

The Revenue Marine and the Revenue Cutter Service, as it was known variously throughout the Nineteenth Century, referred to its ships as cutters. The term is English in origin and refers to a specific type of vessel, namely, "a small, decked ship with one mast and bowsprit, with a gaff mainsail on a boom, a square yard and topsail, and two jibs or a jib and a staysail." (Peter Kemp, editor, *The Oxford Companion to Ships & the Sea*; London: Oxford University Press, 1976; pp. 221–222.) By general usage, that term came to define any vessel of Great Britain's Royal Customs Service and the term was adopted by the U.S. Treasury Department at the creation of what would become the Revenue Marine. Since that time, no matter what the vessel type, the service has referred to its largest vessels as cutters (today a cutter is any Coast Guard vessel over 65-feet in length [and having adequate accommodations for a crew to live on board]).

Coast Guard Cutter Classifications & Designations:

The Revenue Cutter Service designated its cutters and craft based on classes. From about 1890 through the formation of the Coast Guard in 1915, the largest cutters were referred to as vessels of the ["]First Class." The smaller coastal cutters and larger tugs were vessels of the "Second Class," and the smaller tugs and cutters were designated as vessels of the "Third Class." Finally, the small harbor craft were referred to as "Launches."

In 1915, the newly-formed Coast Guard began referring to all of its larger cutters as "Cruising Cutters." At that time, most of the smaller vessels fell under the classification of "Harbor Cutter" and the smallest craft were known as ["Launches."] This changed in 1920 when the Coast Guard divided the "Cruising

Cutter" designation into "Cruising Cutters" for the largest sea-going cutters and "Inshore Patrol Cutters" for those that were primarily coastal vessels.

In 1925, the designation changed once again. Now the largest cutters were known as "Cruising Cutters, First Class," while the coastal cutters were "Cruising Cutters, Second Class." With Prohibition enforcement becoming a major mission, the Coast Guard began adding numerous smaller patrol craft and these were grouped together under the classification of "Patrol Boats." The service also acquired a large number of Navy destroyers to augment the fleet and these were known as, simply, "Coast Guard Destroyers."

In February of 1942, the Coast Guard adopted the Navy's ship classification system whereby a vessel was designated with a two-letter abbreviation based on the type of ship and its hull number. Thus, the large, sea-going cruising cutters of the first class became gunboats, or "PG." To differentiate them from their Navy counterparts, all Coast Guard cutters were given the prefix "W" at that same time. No one knows for sure why the Navy and Coast Guard picked the letter "W" to designate a Coast Guard vessel although rumors abound. One rather bureaucratic argument is that "W" was used during the 1930's as the routing symbol on Treasury Department correspondence to designate the Coast Guard.* Another is that it stands for "weather patrol," one of the major tasks assigned to the Coast Guard.** Or it may be as simple as the fact that "W" was an unused letter on the Navy's designation alphabet and was arbitrarily assigned to designate a Coast Guard cutter. In any case, the practice stuck and each cutter still bears the "W."

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* Robert Scheina. *Coast Guard Cutters & Craft*, 1946–1990. Annapolis: Naval Institute Press, 1990, p. 169 (caption).

**HMC James T. Flynn, Jr., USNR (Ret.), "US Coast Guard 'W' Numbers: Where did they come from and where are they going?" [p. 4]; unpublished paper, USCG Historian's Office files. Chief Flynn notes in the Navy's 1943 ONI-54 pamphlets that "Coast Guard types are prefixed by the letter 'G' . . . Scheina mentions this use of the letter 'G' prefix by the Navy and he further explains that the letter 'W' used by the Coast Guard can be traced back into the 1930s. He also states that the Navy followed suit later in the war (using the W prefix for Coast Guard) when the letter 'G' was needed as a prefix for vessels transferred to Greece[,"] ibid., pp. 3–4.

The service also began assigning an exclusive hull number to each cutter and craft at this time. Prior to 1941, the Coast Guard and its predecessors never assigned hull numbers to its larger cutters or tenders, it simply referred to them only by their names. Some were assigned builders' numbers prior to their construction but that number was never used to designate a cutter that was in commission. The number was dropped after the cutter entered service. [There] is an exception to this practice, however. During the 1920's, patrol boats and the destroyers loaned to the Coast Guard by the Navy did receive hull numbers. Those hull numbers were preceded by the letters "CG." The destroyers kept their names as well and so were the first and only Coast Guard named-vessels, up to that time, that also had hull numbers.

After the end of the war and the Coast Guard's transfer back to the control of the Treasury Department, the Coast Guard continued to use the Navy's system. The large, sea-going cutters were classified primarily as "WPG," "WDE", and "WAVP" (Coast Guard gunboats; Coast Guard destroyer escorts; and Coast Guard seaplane tenders). This changed in 1965 when the service adopted its own designation system and these large cutters were then referred to as Coast Guard High Endurance Cutters or "WHEC." The coastal cutters once known as "Cruising cutters, Second Class" and then "WPC" (Coast Guard patrol craft) under the Navy system were now Coast Guard Medium Endurance Cutters, or "WMEC." Patrol boats continued to be referred to by their Coast Guard/Navy designation, i.e. "WPB." These designations refer to the cutters' capabilities in regards to the length of time they may spend on patrol without replenishment.

Regardless of their changing designations, the cutters in the fleet have always been capable of handling a multitude of missions, sail in any weather, and persevere through any crisis the nation has had. Most have been long-lived as well.

APPENDIX B

Manufacturer Points of Contact

To obtain information related to the industrial base, the RAND team contacted the major manufacturers that are now involved or that will be involved in producing Deepwater surface and air assets. The surface and air manufacturers we contacted are listed in Tables B.1 and B.2, respectively. Each was asked to complete a survey containing detailed questions about its current labor force, availability of workers, overhead rates, production schedules (for Deepwater and non–Deepwater work), facilities requirements, capacity, lead times, cost impacts associated with acceleration schemes, and other relevant information. The survey is included as Appendix C. RAND visited each manufacturer to review the completed survey and discuss additional issues.

Table B.1
Manufacturers of Major Surface Assets

Asset Class	Manufacturer
National Security Cutter (NSC)	Northrop Grumman Ship Systems (NGSS)
Offshore Patrol Cutter (OPC)	NGSS
Fast Response Cutter (FRC)	Bollinger
PB-110–to–PB-123 Conversions	Bollinger

Table B.2
Manufacturers of Major Air Assets

Asset Class	Manufacturer
HH-65–to–MCH Conversions	Eurocopter
MPA	CASA
VRS	Agusta/Bell
VUAV	Bell Helicopter

APPENDIX C
Shipbuilder Survey Instrument

RAND Study on the Deepwater Acceleration for the US Coast Guard

Introduction:

RAND has been contracted by the US Coast Guard to examine the potential options of accelerating the Deepwater program and adding additional capabilities as a result of new homeland security requirements. As part of the study, we need to obtain basic data on production plans and labor requirements for your firm's involvement with Deepwater. We ask that you help us in this study by providing the requested information on the subsequent worksheets. We realize that your firm may consider some of the data proprietary in nature. Accordingly, we are willing to sign a non-disclosure agreement with your firm that would restrict the use of the information that you provide.

Sponsor:

Name?
Title?
Agency?

Project Monitor:

Name?
Title?
Agency?

RAND Principal Investigators:

Mr. John Birkler
Senior Researcher
RAND
1700 Main St.
PO Box 2138
Santa Monica, CA 90407-2138
(310) 393-0411 ext. 7607
birkler@rand.org

Mr. John Schank
Senior Operations Research Analyst
RAND
1200 South Hayes Street
Arlington, VA 22202-5050
(703) 413-1100 ext. 5304
schank@rand.org

Directions:

Included are additional worksheets requesting data in several different areas. Please complete the worksheets as best you can. If you have questions, please contact one of the principal investigators listed above. Also, please provide contact information for the individuals completing these forms. A space is provided below. If you have supplementary information, Please feel free to attach it to this file.

Company Contact Information

Name	Title	Phone	Email

Who we are:

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Our job is to help improve policy and decision making through research and analysis. We do that in many ways. Sometimes, we develop new knowledge to inform decision makers without suggesting any specific course of action. Often, we go further by spelling out the range of available options and by analyzing their relative advantages and disadvantages. On many other occasions, we find the analysis so compelling that we advance specific policy recommendations.

RAND (a contraction of the term research and development) is the first organization to be called a "think tank." We earned this distinction soon after we were created in 1946 by our original client, the U.S. Air Force (then the Army Air Forces). Some of our early work involved aircraft, rockets, and satellites.

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For example:

* The U.S. Department of Education recently commended RAND for our exemplary drug prevention program for schoolchildren.
* The pharmaceutical company Pfizer asked RAND to examine the quality of health care for elderly patients.
* Leaders in Indonesia asked RAND to assess how that country's economic crisis has affected its citizens.
* A major manufacturer engaged RAND to provide workforce modeling and planning expertise to position its global engineering workforce for the future.

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Workforce Data

Workers Currently Employed

	Direct laborers	Direct Engineers	Other Direct	Indirect Workers
Number of Workers				
Average Direct Hourly Wage Rate				
Average Hiring Cost				
Termination Cost				

Workforce Distribution by Age

Number of workers that are:

	Direct laborers	Direct Engineers	Other Direct	Indirect Workers
less than 40 years old				
40 to 50 years old				
50 to 60 years old				
greater than 60 years old				

Workforce Distribution by Experience

Number of workers with shipbuilding experience of:

	Direct laborers	Direct Engineers	Other Direct	Indirect Workers
less than one year				
one year				
two years				
three years				
four years				
five years				
more than five years				

What is the standard / average number of hours per year that a full time employee works?

Employment Differences by Experience

	Attrition Rate (% annual loss)	Productivity % (relative to highest skilled worker)	Average, Direct Wage Rate ($/hr)	Annual Training Cost
less than one year				
one year				
two years				
three years				
four years				
five years				
more than five years				

Training and Hiring of Workers

Please, briefly, describe the training process for new workers:

Is formal mentoring used? If so, what are the typical ratios between new hires and experienced workers?

If workers have been previously laid-off, can they be rehired later? What fraction of the workers can be rehired? For how long? Please describe

When hiring workers, what are the typical experience levels of the candidate pool?

	% of total pool
less than one year	
one year	
two years	
three years	
four years	
five years	
more than five years	

In order to meet peaks in workload, do you employ temporary / contract workers? Please explain:

Deepwater Production Plans

We would like to have an understanding of your current plans for Deepwater Production

Number /	Type / Class of Item (e.g. ship, aircraft, etc.)	Model Name (e.g. NSC, HC-130, etc.)	Type of Work (e.g. New, Repair, Module, etc.)	Start of Engineering / Planning (month/year)	End of Engineering / Planning (month/year)	Start of Construction (month/year)	End of Construction (month/year)	Delivery (month/year)	Lot Size
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

Note: if more than 25 activities are planned, please expand list

Workload Projections for Non Deepwater Work

Please provide workload projections (in hours) for the next several years as far into the future as possible. Please do not include Deepwater workload.

Year	Quarter	Direct laborers	Direct Engineers	Other Direct	Indirect Workers
2002	1				
2002	2				
2002	3				
2002	4				
2003	1				
2003	2				
2003	3				
2003	4				
2004	1				
2004	2				
2004	3				
2004	4				
2005	1				
2005	2				
2005	3				
2005	4				
2006	1				
2006	2				
2006	3				
2006	4				
2007	1				
2007	2				
2007	3				
2007	4				
2008	1				
2008	2				
2008	3				
2008	4				
2009	1				
2009	2				
2009	3				
2009	4				
2010	1				
2010	2				
2010	3				
2010	4				
2011	1				
2011	2				
2011	3				
2011	4				
2012	1				
2012	2				
2012	3				
2012	4				
2013	1				
2013	2				
2013	3				
2013	4				

Resource Requirements for Deepwater Activities

For *each* activity listed on the "Deepwater Plans" worksheet, please provide the requested information with respect to the workload demand for the facility. For an activity that occurs more than once, please complete for the first occurrence. Subsequent, identical activities should refer to the learning slopes. Please provide all cost values if priced today (i.e. 2002 $).

Activity

Name	
Type / Class of Item	
Model Name	
Type of Work	
Number on "Deepwater Plans"	

Direct Costs

Recurring Investment	
Recurring Material and Equipment	

Direct Labor Hours

	Quarter	Recurring Direct labor	Recurring Direct Engineering	Recurring Other Direct	Non-Recurring Direct Engineering
Start	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				

What is the offset between the non-recurring engineering and the first unit (in quarters)?

Learning Curve Slope

Engineering	
Labor	

Facilities Production Equipment Investments for Deepwater Activities

In order to manufacture Deepwater items, it is possible that your firm may require facilities upgrades, expansions, and the addition of new tooling and equipment. Please itemized description of the improvements/investments needed.
Please provide all cost values if priced today (i.e. 2002 $).

Current Deepwater Plan

#	Investment Description	Required for Deepwater Item (e.g. NSC, HC-130, etc.)		Investment Lead-time (months)	Completion Date (mo/yr)	Investment Cost ($)	Capitalized or Expensed?	If expensed, what is the depreciation schedule?
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Accelerated Deepwater Plans

Investment Cost Sensitivity to Production Rate

For each item identified above, please provide the investment cost under different production rates. Also, if additional facilities are need at higher rates, please include a description on the table below

	Production Rate Relative to current plan:	1x	1.5x	2x	2.5x	3x
				Investment Cost		
#	Investment Description					
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Additional facilities needed at higher production rates

#	Investment Description	Required for Deepwater Item (e.g. NSC, HC-130, etc.)		Investment Lead-time (months)	Completion Date (mo/yr)	Investment Cost ($)	Capitalized or Expensed?	If expensed, what is the depreciation schedule?

Burden Data

Definition: The term "burden" refers to overhead, general and administrative (G&A), fee/profit, and cost of money (COM) charges. These costs which are proportional to the direct hours and are, typically, billed as a percentage of the direct labor hours. Most of this information should be contained in your FPRA (if you have one). If possible, please also attach your current FPRA.

What burden/overhead cost pools do you use, what costs are included in each, and how are costs allocated?

Are there burden/overhead costs that are spread to more than one location?

Which do you consider fixed annual costs, and which are variable?

Please provide in the table below how burden/overhead changes as a function of the current business base. If you have separate pools for engineering and direct labor, please provide the information for each pool.

% Change in Business Base	Direct Hours	Overhead Rate	G&A Rate	Other: ________	Wrap Rate
50%					
40%					
30%					
20%					
10%					
0%					
-10%					
-20%					
-30%					
-40%					
-50%					

Are fringe costs (vacation, health, sick leave, etc.) included in the overhead rate? If not, please provide the current rate as a fraction of the current direct rate.

Direct labor	Direct Engineering	Other Direct

Are fringe costs (vacation, health, sick leave, etc.) included in the overhead rate? If not, please provide the current rate as a fraction of the current direct rate.

Direct labor	Direct Engineering	Other Direct

Do you have a burden rate for COM (cost of money) recovery? If so, please provide your current rates.

Direct labor	Direct Engineering	Other Direct

Please provide an example of how you build-up a direct rate to a total wrap rate.

APPENDIX D

Force Structure Levels for 60-Percent and 80-Percent Mission Coverage of Traditional and Emerging Asset-Presence Demands

The second line-of-inquiry question the RAND team addressed in Chapter Four involved determining the assets that would be required to perform the anticipated missions with 100 percent of the needed asset presence. The force structure needed for 100-percent coverage of asset-presence demands, dubbed the 100-Percent Force Structure, was presented in that chapter. This appendix describes in abbreviated form what the force structure would look like to cover the asset-presence demands for traditional missions and emerging responsibilities at the 60- and 80-percent levels.

We assumed that adequate asset levels would be maintained in order to satisfy 100 percent of the asset-presence demands for training, search and rescue, and ice patrol missions. We chose training because "future assets must continue to shift rapidly from planned routine operations to unscheduled emergencies requiring vastly different capabilities," and "these transitions, so frequent in Coast Guard operations, can only be made by multi-mission assets crewed by well-trained, experienced professionals" (USCG, 1996, p. 15). We chose search and rescue because "maritime tradition and international law require Coast Guard assets to respond to distress requests for assistance in any area that they are operating in, regardless of location" and because "the Coast Guard must retain its position as the world's leader in this vital humanitarian mission" (USCG, 1996, p.2). We chose ice patrol missions because "since 1914 the Coast Guard has been responsible for the management and operation of the International Ice Patrol (IIP)" (USCG, 1996, p. 3).

We then reduced the number of assets so that the asset-presence demands for the remaining missions are satisfied at the 60- and 80-percent levels.

The RAND research team used the following methodology to evaluate the 80- and 60-percent mission-coverage levels. With the 100-percent mission-coverage levels presented in Chapter Four as a starting point, we used the results of two Center for Naval Analyses (CNA) studies (Nordstrom and Partos, 2002; East et al., 2000) to determine how many of the air assets are needed to provide 100-percent coverage of training, search and rescue, and ice patrol missions. This information is summarized in Table D.1. The total listed in the right-hand column corresponds to the total number of assets needed to provide 100-percent coverage for all missions, as described in Chapter Four. We fixed the number of air assets needed for training, search and rescue, and ice patrol missions and reduced the

Table D.1
Air Assets of Total Force Structure Needed to Meet 100 Percent of Demands of Traditional Missions and Emerging Responsibilities

Asset	Search and Rescue, Training, and Special Operations Missions	Other Missions	Total
Maritime Patrol Aircraft (MPA)	7	28	35
High Altitude Endurance Unmanned Air Vehicle (HAEUAV)	0	25	25
Vertical Recovery System (VRS)	32	1	33
Multimission Cutter Helicopter (MCH)	72	67	139
Vertical Unmanned Air Vehicle (VUAV)	3	120	123

number both of air assets for remaining missions and of all surface assets by 60 and 80 percent to produce estimates of the number of assets needed to provide coverage at the 60 and 80 percent levels, respectively. For example, we see from Table D.1 that 35 Maritime Patrol Aircraft (MPA) are needed to provide 100-percent mission coverage. Of the 35, seven are required to provide 100-percent coverage of training, search and rescue, and ice patrol missions. Hence, 29 MPA are needed for 80-percent coverage of the other missions and 100-percent coverage of the first three missions, a figure we calculated as follows:

$$0.8 \times (35 - 7) + 7 = 29.$$

The force-structure levels to provide 100-percent, 80-percent, and 60-percent coverage of traditional missions and emerging responsibilities are summarized in Table D.2, which also lists the force-structure levels for the original 20-year Deepwater acquisition plan, for comparison.

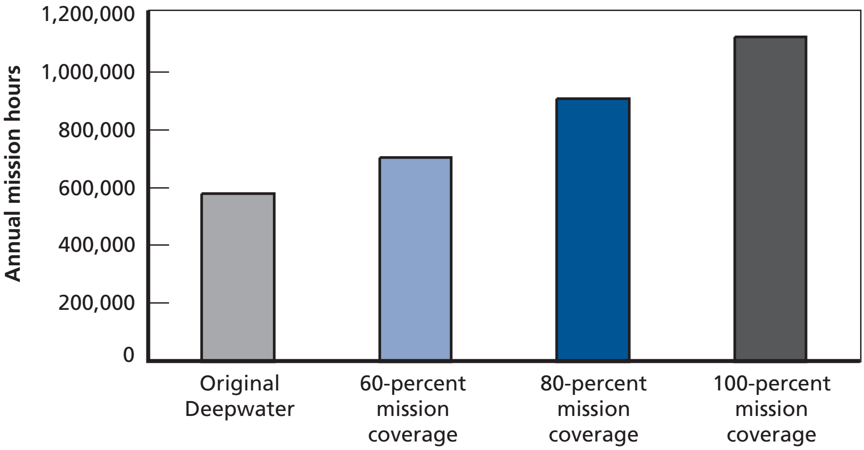
In Chapter Four, we presented a detailed acquisition schedule, cost estimates, and performance estimates for the force structure needed to provide 100-percent coverage of traditional missions and emerging responsibilities. Although we did not develop detailed acquisition schedules or cost estimates for the 60- and 80-percent mission-coverage cases considered in this appendix, we discuss performance estimates for the 60- and 80-percent mission-coverage cases in abbreviated form.

Table D.2
Force-Structure Levels for 20-Year Deepwater Acquisition and 100-Percent, 80-Percent, and 60-Percent Coverage Levels for Traditional Missions and Emerging Responsibilities

Asset	Number			
	In Original Deepwater Plan	Needed to Meet 60% of Demands of Traditional Missions and Emerging Responsi-bilities	Needed to Meet 80% of Demands of Traditional Missions and Emerging Responsi-bilities	Needed to Meet 100% of Demands of Traditional Missions and Emerging Responsi-bilities
National Security Cutter (NSC)	8	26	35	44
Offshore Patrol Cutter (OPC)	25	28	37	46
Fast Response Cutter (FRC)	58	54	72	90
Maritime Patrol Aircraft (MPA)	35	24	29	35
High Altitude Endurance Unmanned Air Vehicle (HAEUAV)	7	13	17	25
Vertical Recovery System (VRS)	34	33	33	33
Multimission Cutter Helicopter (MCH)	93	112	126	139
Vertical Unmanned Air Vehicle (VUAV)	69	75	99	123

In Chapters Three and Four, we defined and discussed three performance measures: annual mission hours, annual detection-coverage area of airborne sensors, and port protection under the highest alert level, MARSEC III, conditions. Figure D.1 summarizes the annual number of mission hours for the force acquired with the original 20-year Deepwater plan, and the force structures for 100-percent, 80-percent, and 60-percent asset presence for coverage of traditional missions and emerging responsibilities.

Figure D.1
Annual Mission Hours for 20-Year Deepwater Acquisition and 100-Percent, 80-Percent, and 60-Percent Mission-Coverage Levels, for Comparison



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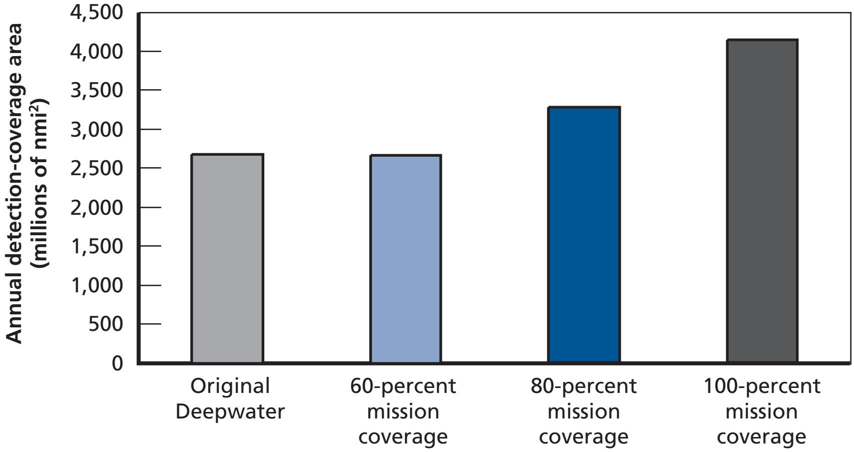
Observe that the force structure for 60-percent coverage of traditional missions and emerging responsibilities, for example, does not necessarily provide 60 percent of the mission hours of the force structure for 100-percent coverage of traditional and emerging mission demand (although it does so approximately). The reason is that the asset levels for search and rescue, training, and ice patrol missions were kept at the 100-percent levels.

Figure D.2 summarizes the annual detection-coverage area of airborne sensors for the force acquired with the original 20-year Deepwater plan, and the force structures for 100-percent, 80-percent, and 60-percent coverage of traditional missions and emerging responsibilities. Again, it is not necessarily the case that the force structure for 60-percent coverage of traditional and emerging mission demands, for example, provides 60 percent of the airborne sensor coverage area of the force structure for 100-percent coverage of traditional and emerging mission demand (although it approximates it). Again, the reason is that asset levels for training, search and rescue, and ice patrol missions were kept at the 100-percent levels. Note that

Figure D.2
Annual Detection-Coverage Area of Airborne Sensors: 20-Year Deepwater Acquisition and 100-Percent, 80-Percent, and 60-Percent Mission-Coverage Levels, for Comparison

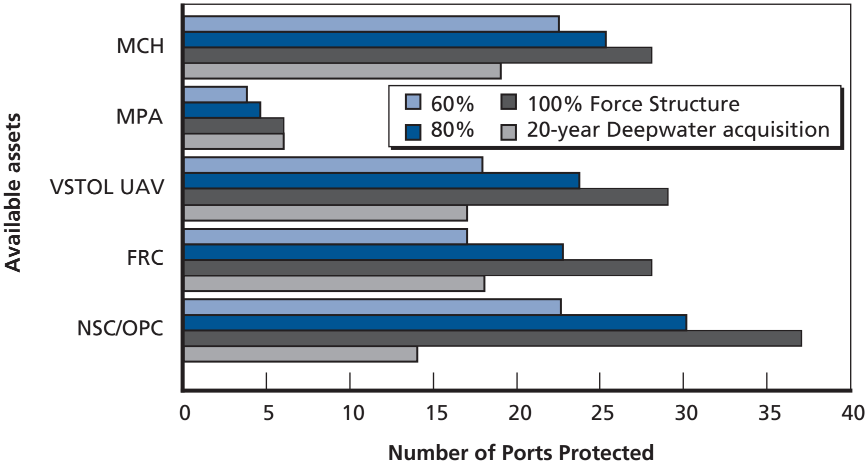


RAND *MG114-D.2*

the force structure acquired with the original 20-year Deepwater plan actually provides more airborne sensor detection coverage area than the force structure for 60-percent coverage of traditional and emerging mission demands, because 35 Maritime Patrol Aircraft are in the original 20-year Deepwater plan and only 24 are in the force structure for 60-percent coverage of traditional missions and emerging responsibilities.

Figure D.3 summarizes the number of ports that can be protected under the highest alert level, MARSEC III, conditions, by asset type. It is an extension of Figure 4.3. Note that the number of MPA are reduced to 80 percent for the 80-percent mission-coverage force structure and to 60 percent for the 60-percent mission coverage force structure. Hence, the number of ports that can be protected under MARSEC III conditions is reduced to 80 percent, from 6 to 4.8, under the force structure that provides 80-percent coverage of traditional and emerging mission demand. Similarly, the number of ports that can be protected under MARSEC III conditions is reduced to 60 percent, from 6 to 3.6, under the force structure that provides 60-percent coverage of traditional missions and emerging responsibilities.

Figure D.3
Number of Ports That Can Be Protected Under MARSEC III Conditions: Standard Asset Availability Rates for 20-Year Deepwater Acquisition and 100-Percent, 80-Percent, and 60-Percent Mission-Coverage Levels



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